

LONG ISLAND TRAINING  
SEPTEMBER 23, 2010



**ENERGY STAR Qualified Homes Version 3:**  
**Assured Performance**  
**with Every Labeled Home**

ENERGY STAR QUALIFIED HOMES VERSION 3

## OUTLINE

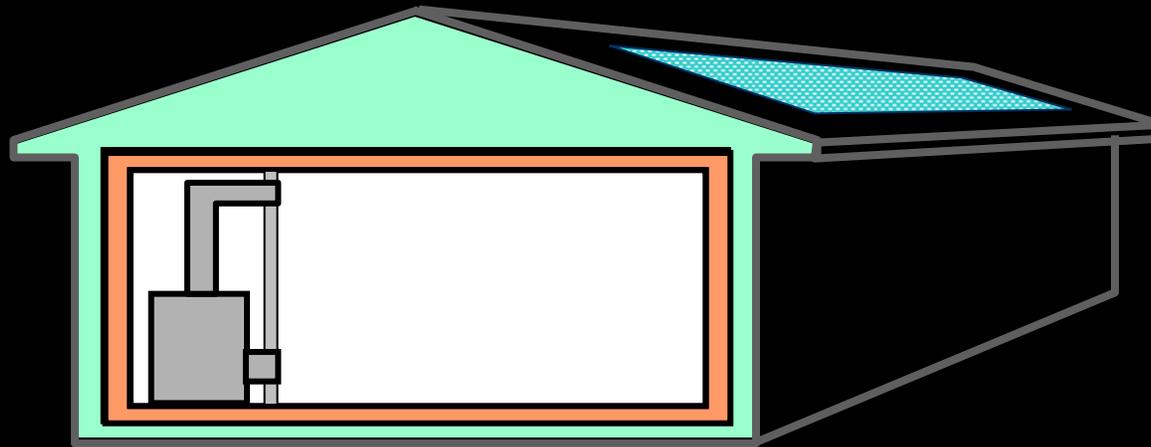
- **The Product:** Dissecting the Home Purchase
- **The Context:** Energy Star vs. 'Green'

### The New Normal

- **The Business Case:** Addressing New Normal
- **The Metrics:** Why Energy Star = Good Policy

THE PRODUCT

# DISSECTING THE HOME PURCHASE



- Home = Liability
- **Building Science**
- Renewable Power = Investment + BOH

THE CONTEXT

# ENERGY STAR vs. GREEN



**ENERGY STAR  
for Homes**

**Green Programs  
for Homes**

**Voluntary**

**Recognizes Builders**

Label

Web Site, Marketing, Awards



THE CONTEXT  
ENERGY STAR vs. GREEN



**ENERGY STAR  
for Homes**

**Green Programs  
for Homes**

**Voluntary**

**Recognizes Builders**

Label

Web Site, Marketing, Awards

**Defines Efficient**

Rigorous Specifications

Third-Party Verified

**Offers Flexibility**

Points

Multiple Tiers

THE CONTEXT

# 'GREEN' BEGINS WITH 'BLUE'



## Energy Efficiency

- Air Flow
- Thermal Flow
- Moisture Flow
- Equipment



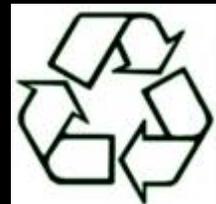
## Indoor Environment

- Source Control
- Ventilation
- Filtration



## Resource Efficiency

- Water
- Materials
- Waste
- Recycling
- Land
- Renewables



# THE NEW NORMAL

- **Smaller Universe of Buyers**
  - 75% Fewer Housing Starts
  - Tighter Credit = Less Qualified Buyers
  - Less Compelling Reasons to Buy
- **You Can't Compete on Price**
  - Massive Inventory of Fire-Sale Homes
  - Massive Inventory of Homes Under Water
- **High-Performance Train Has Left the Station**
  - Energy Codes on Hyper Drive
  - Net-Zero Home Programs
- **A New Technology Change Everything**
  - Hint, it Has Nothing to Do with Housing

# LOW COST INFRARED CAMERAS

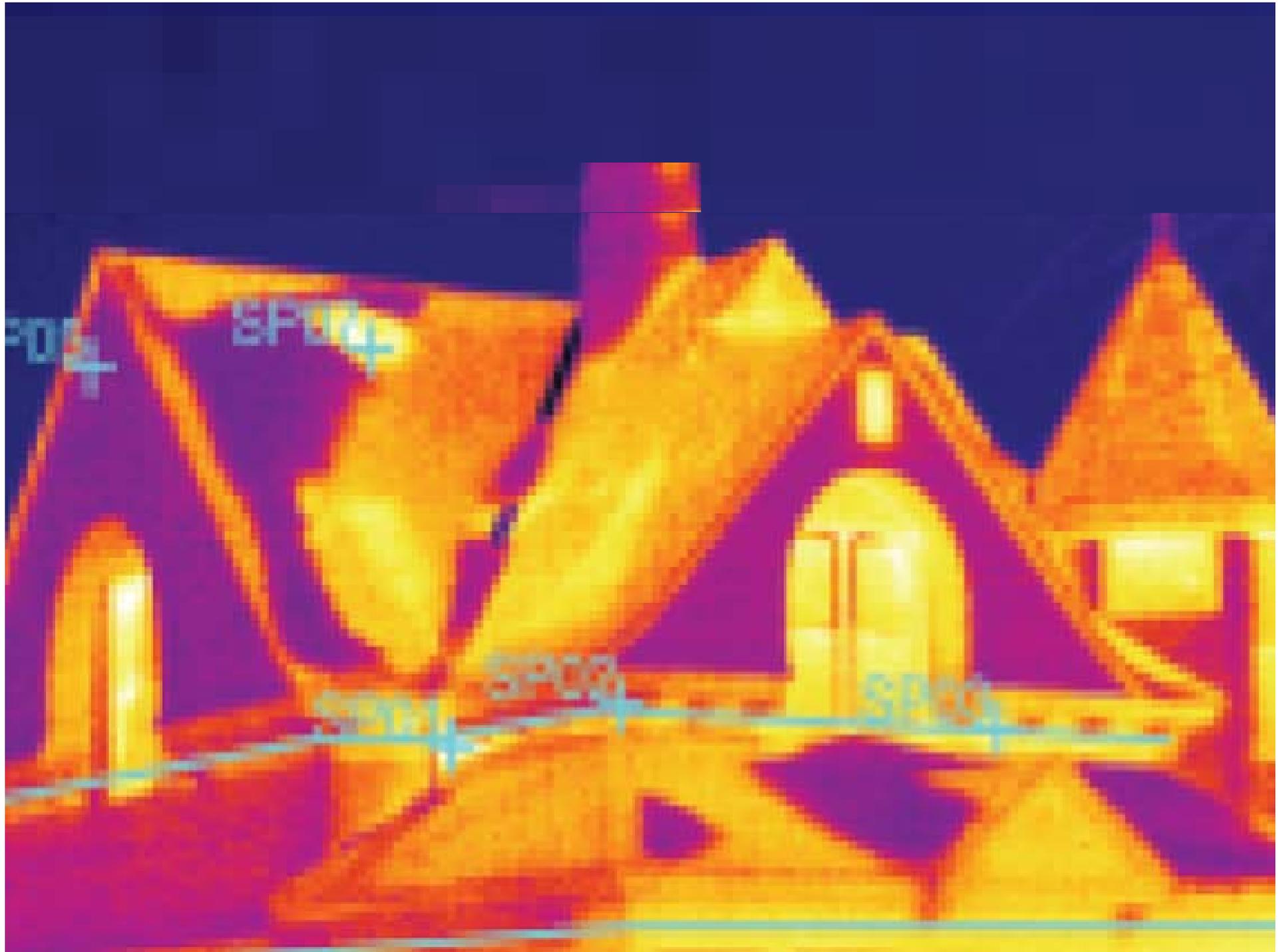
*The best thermal imager  
for the money.*

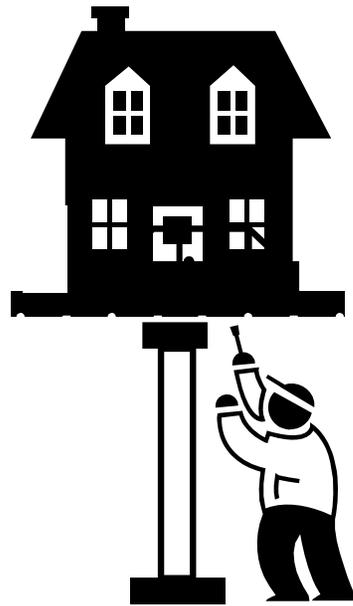


**\$2,495**

[Learn More](#)









# WHY ENERGY STAR FOR HOMES SPECIFICATIONS CRITICAL



**A voluntary labeling program that:**

## **Defines Energy Efficient**

**Rigorous Specifications**

Third-Party Verified

## **Recognizes Builders**

Government-Backed Label

Web Site, Marketing, Awards

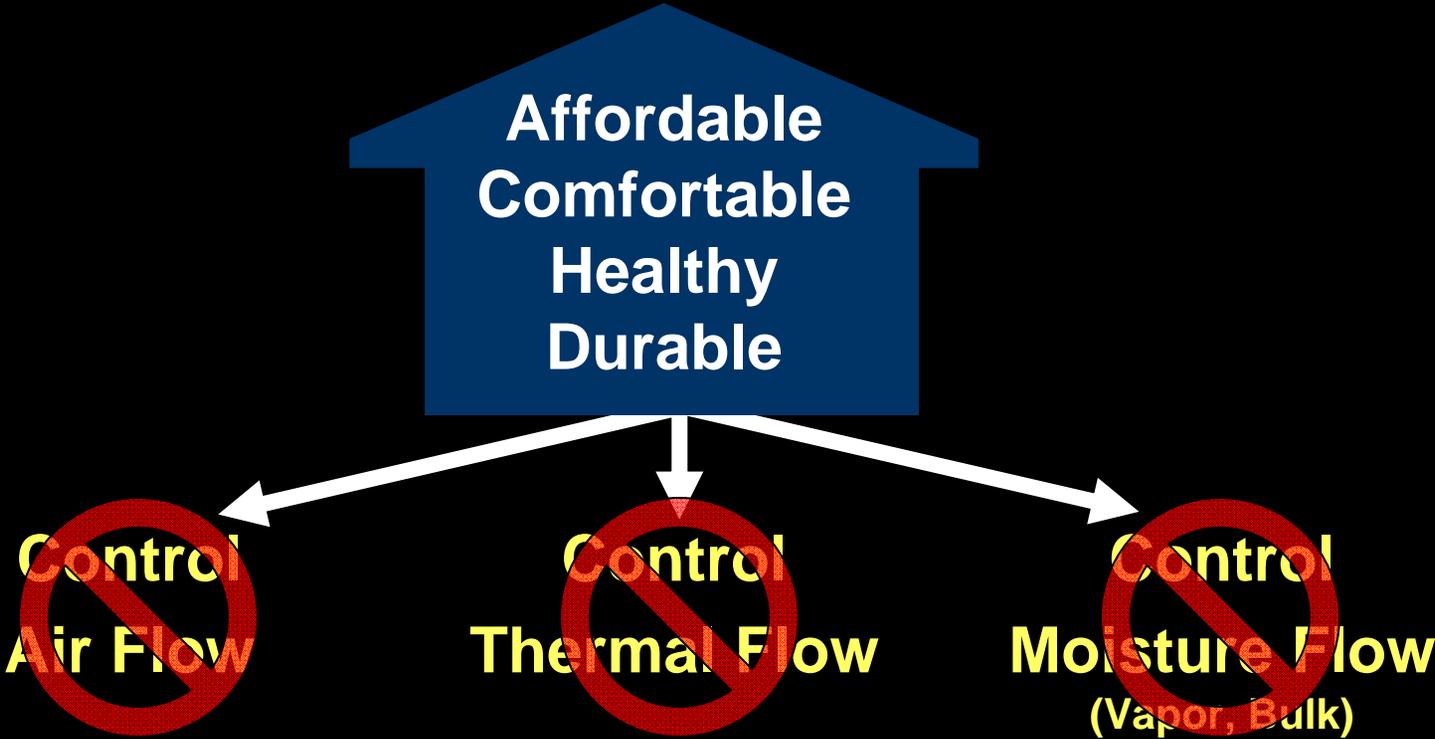
THE BUSINESS CASE:  
BUSINESS QUESTION...



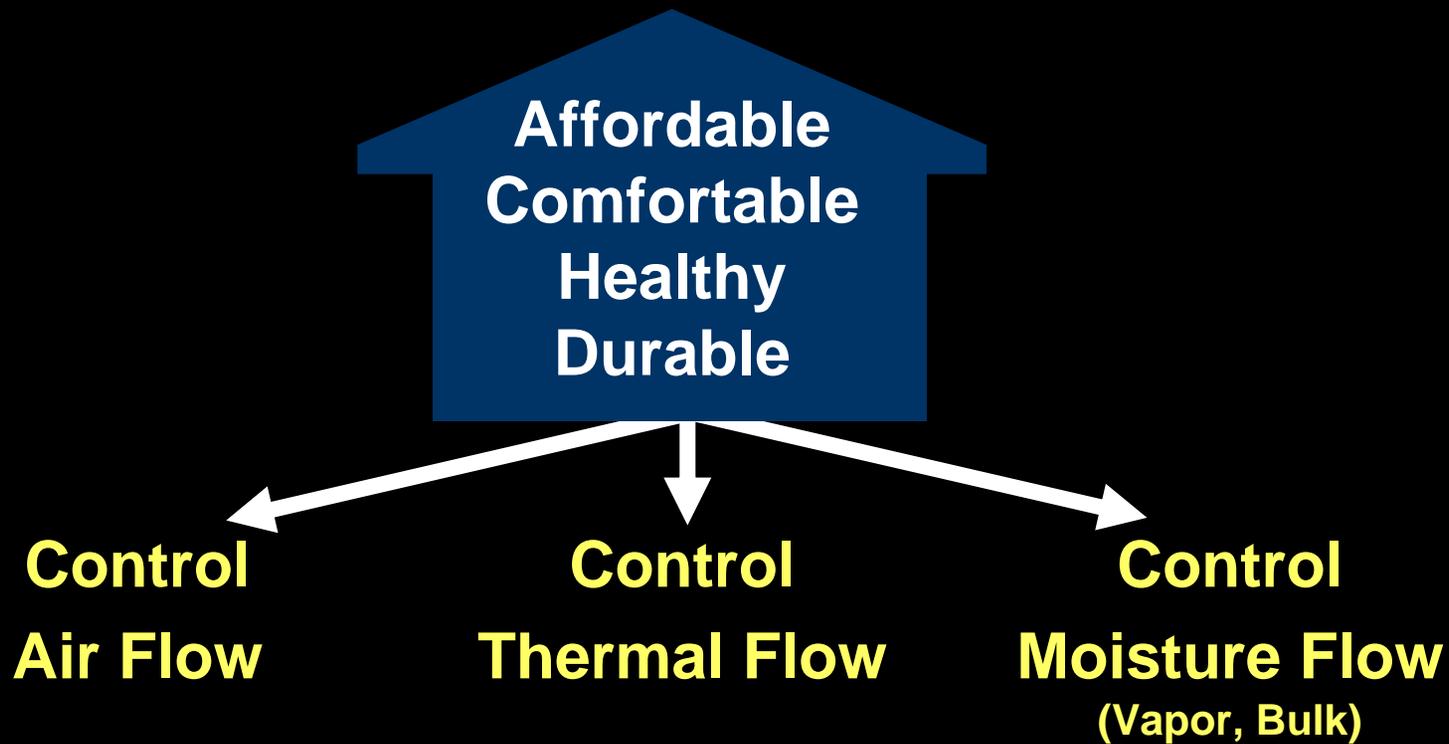
If ENERGY STAR for Homes is the solution...

**What's the Problem?**

# PROBLEM: HOMES THAT FAIL



# SOLUTION: HOMES THAT WORK



# Defining Energy Efficient



Affordable  
Comfortable  
Healthy  
Durable

Control  
Air Flow

Control  
Thermal Flow

Control Moisture Flow  
Vapor Bulk

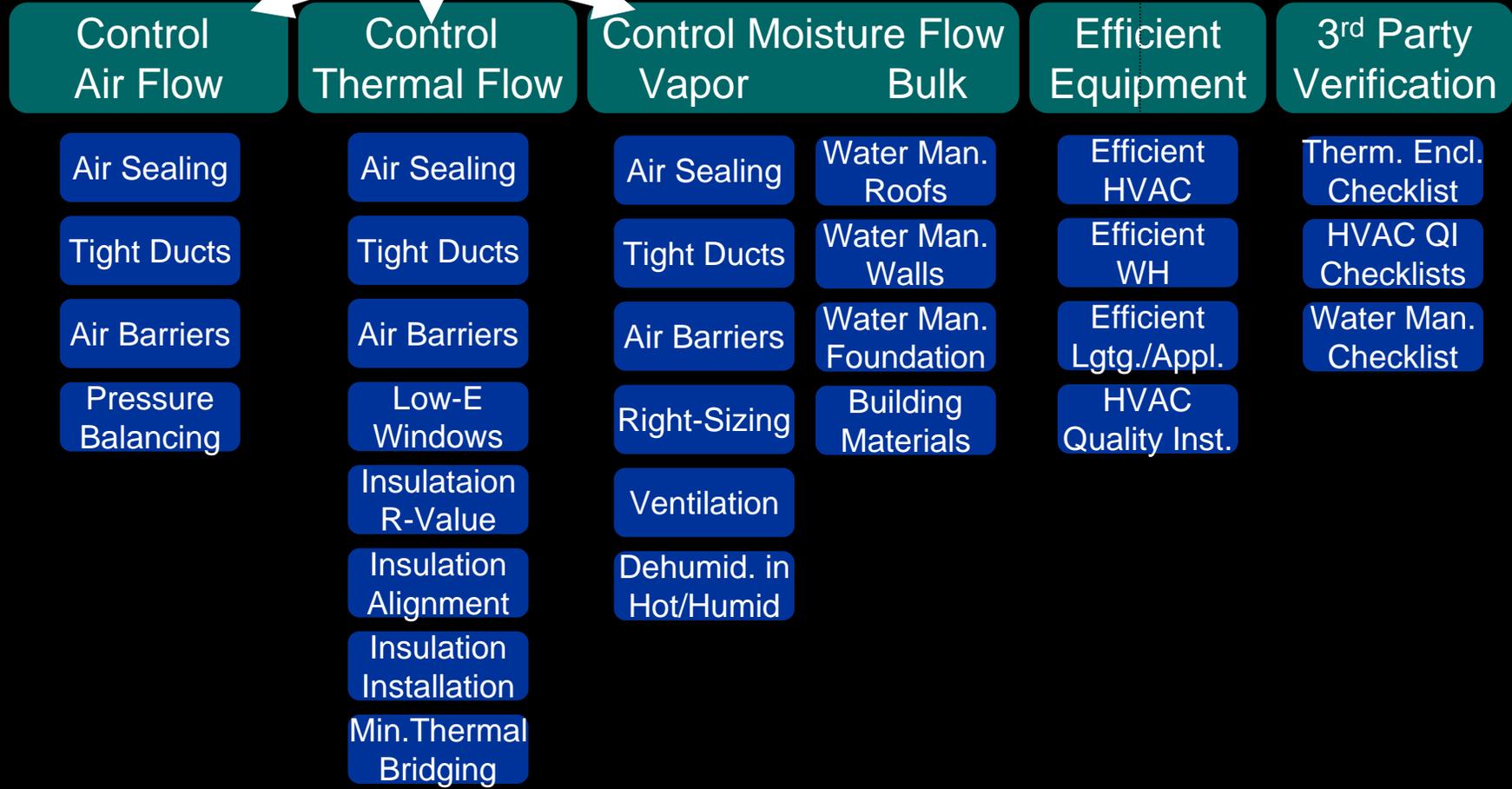
Efficient  
Equipment

3<sup>rd</sup> Party  
Verification

# Defining Energy Efficient



Affordable  
Comfortable  
Healthy  
Durable



IF ENERGY STAR QUALIFIED HOMES IS THE SOLUTION,  
**WHAT'S THE PROBLEM?**

**Solution**

**Problem**

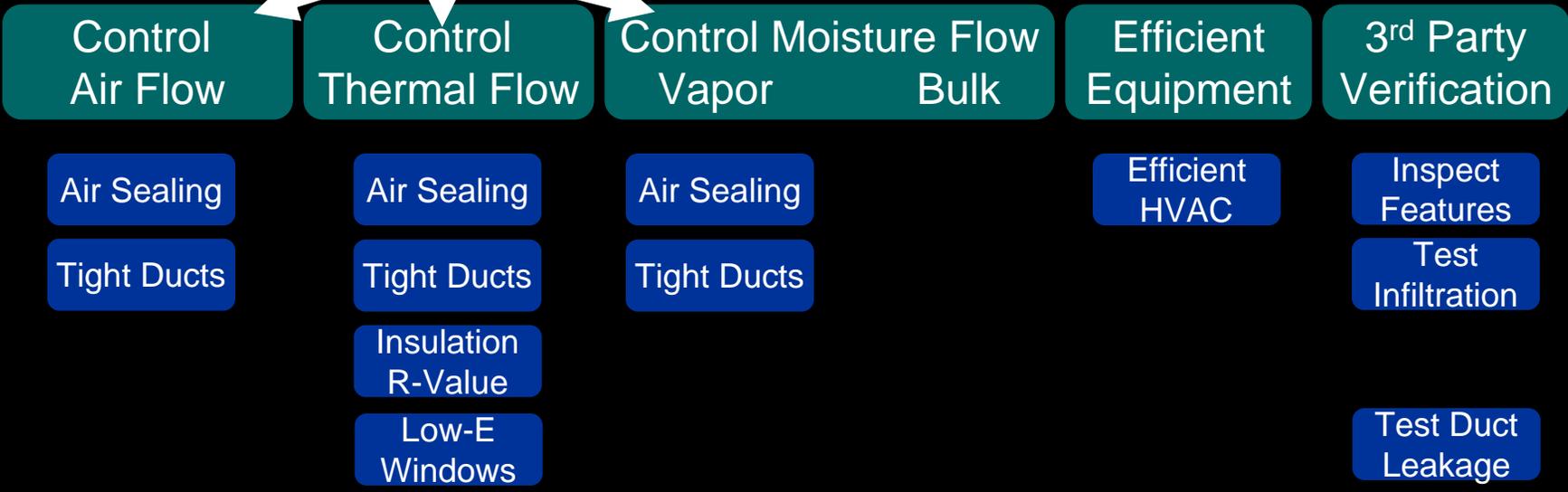
**Energy Star V.1**

**Low Hanging Fruit Missing  
Lack of Verification Infrastructure**

# Defining Energy Efficient



Affordable  
Comfortable  
Healthy  
Durable



  
**1996**  
**V.1**

IF ENERGY STAR QUALIFIED HOMES IS THE SOLUTION,  
**WHAT'S THE PROBLEM?**

**Solution**

**Problem**

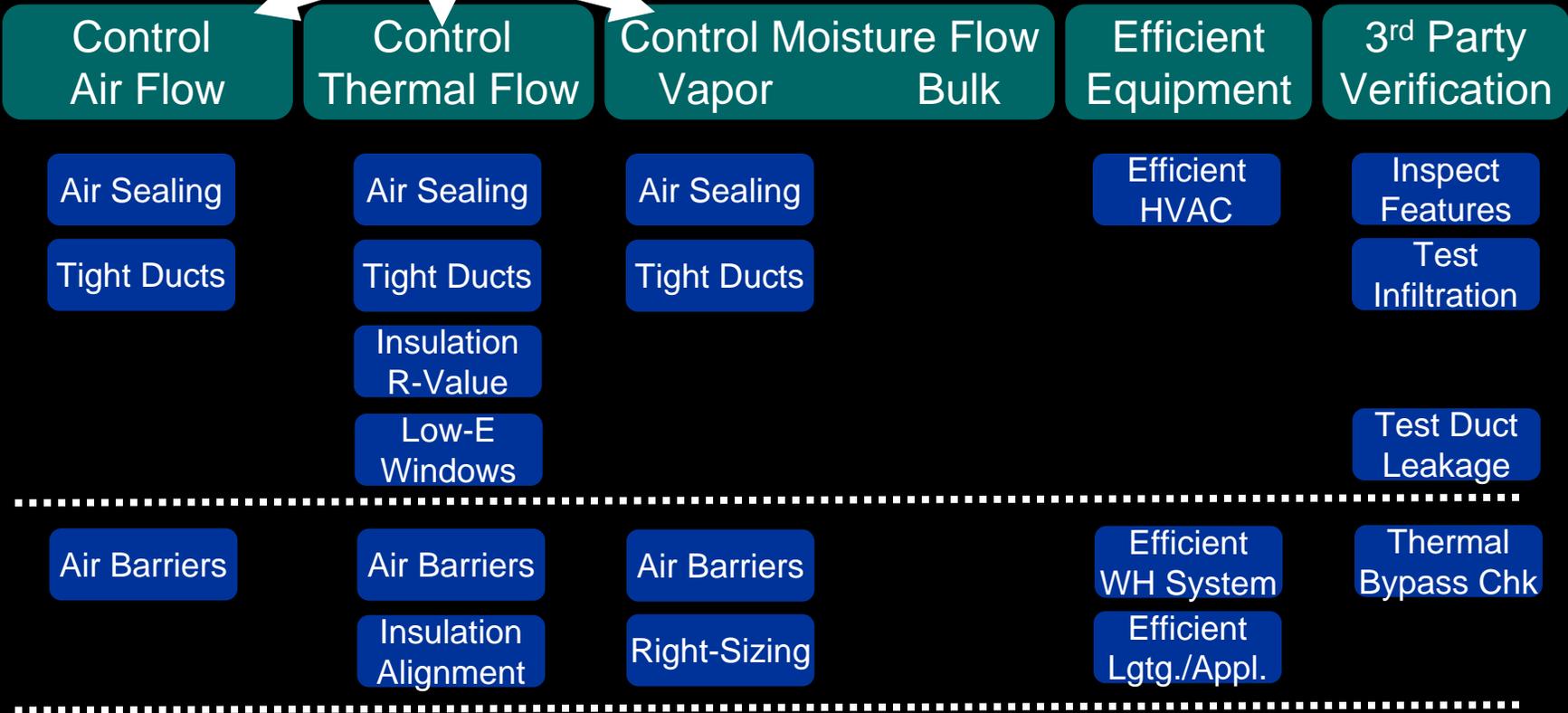
Energy Star V.1

Low Hanging Fruit Missing  
Lack of Verification Infrastructure

**Energy Star V.2**

**Lack of Initial Building Science**  
**Lack of Energy Star Components**

# Defining Energy Efficient



  
**1996**  
**V.1**

  
**2006**  
**V.2**

IF ENERGY STAR QUALIFIED HOMES IS THE SOLUTION,  
**WHAT'S THE PROBLEM?**

**Solution**

**Problem**

Energy Star V.1

Low Hanging Fruit Missing  
Lack of Verification Infrastructure

Energy Star V.2

Lack of Initial Building Science  
Lack of Energy Star Components

**Energy Star V.3**

**Lack of Complete Building Science**  
**Lack of Quality Assurance**

# Defining Energy Efficient



	Control Air Flow	Control Thermal Flow	Control Moisture Flow Vapor Bulk	Efficient Equipment	3 <sup>rd</sup> Party Verification
<b>1996 V.1</b>	Air Sealing Tight Ducts	Air Sealing Tight Ducts Insulation R-Value Low-E Windows	Air Sealing Tight Ducts	Efficient HVAC	Inspect Features Test Infiltration Test Duct Leakage
<b>2006 V.2</b>	Air Barriers	Air Barriers Insulation Alignment	Air Barriers Right-Sizing	Efficient WH System Efficient Lgtg./Appl.	Thermal Bypass Chk Thermal Enclos. Chk HVAC Sys. QI Chk
<b>2011 V.3</b>	Pressure Balancing	Insulation Installation Min. Thermal Bridging	Ventilation Dehumid. in Hot/Humid	Water Man. Construction Building Materials HVAC Quality Inst.	Water Man. System Chk

  
**1996**  
**V.1**

  
**2006**  
**V.2**

  
**2011**  
**V.3**

ENERGY STAR QUALIFIED HOMES VERSION 3  
**PROGRAM REQUIREMENTS**



**Ref. Design:**

[Performance or Prescriptive\*]

- **Efficient Htg./Cooling**
- **Efficient Envelope**
- **Efficient Components**



**Mandatory Checklists:**

- **Thermal Enclosure**
- **HVAC Quality Installation (2)**
- **Water Managed Construction**

\* Prescriptive Path only allowed for homes  $\leq$  Benchmark Home size

ENERGY STAR QUALIFIED HOMES VERSION 3

# PERFORMANCE PATH PROCESS



## Initial HERS Index Target Score

### House Take-Offs:

- Square Footage by Floor
- Wall Areas by Orientation
- Roof Area
- Opaque Door Areas by Orientation

### Assumptions:

- Max. 15% Glazing
- Glazing Evenly Distributed

## Reference Design Specifications

X

## Size Adjustment Factor

=

## Final HERS Index Target Score

ENERGY STAR QUALIFIED HOMES VERSION 3

# SIZE ADJUSTED TARGET SCORE



## Benchmark Home Size

BRs	1	2	3	4	5	6	7	8
CFA	1,000	1,600	2,200	2,800	3,400	4,000	4,600	5,200

$$\left[ \frac{\text{CFA Benchmark Home}}{\text{CFA Rated Home}} \right]^{0.25} \times \text{HERS Index Target Score}$$

Size Adjustment Factor not to exceed 1.0

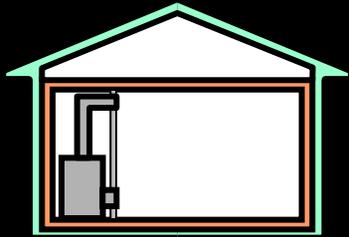
ENERGY STAR QUALIFIED HOMES VERSION 3  
SIZE ADJUSTMENT EXAMPLE



5,000 sf, 4 BR Home with HERS Index Target Score of 78

$$\left[ \frac{2,800 \text{ sf 4-BR benchmark home}}{5,000 \text{ sf 4-BR rated home}} \right]^{0.25} \times 78$$

= **67** ENERGY STAR HERS Index Target Score



# MANDATORY REQUIREMENTS CHECKLISTS



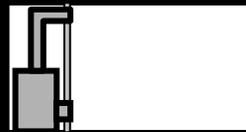
## Thermal Enclosure System:

- Air Leakage
- Insulation R-Value
- Insulation Installation
- Air Barriers
- Thermal Bridging
- High-Perf. Windows



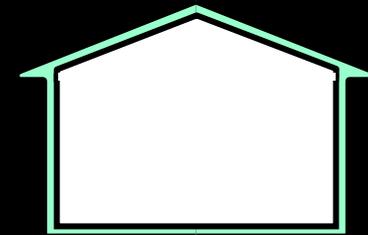
## HVAC Quality Installation System:

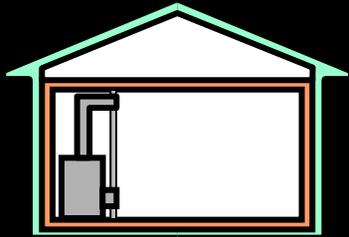
- Efficient Equipment
- Right-Sizing
- Air Distribution
- Refrigerant Charge
- Duct Installation
- Pressure Balancing
- Ventilation
- Filtration



## Water Management System:

- Roof Membranes
- Flashing
- WRB's
- Fabric Filters
- Capillary Breaks
- Drainage Layer





# MANDATORY REQUIREMENTS CHECKLISTS



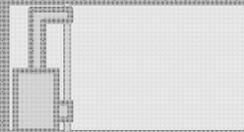
## Thermal Enclosure System:

- Air Leakage
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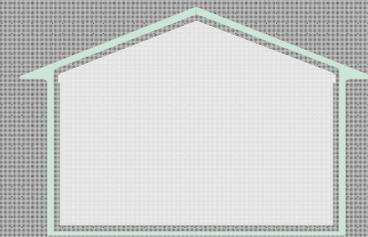
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## Water Management System:

- Roof Membranes
- Flashing
- WRB's
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- Drainage Layer



BUILDING SCIENCE

DRIVING FORCES ALWAYS MOVE AIR  
SAME DIRECTION



**More**

Pressure

Heat

Moisture

to

**Less**

Pressure

Heat

Moisture

AIR SEALING  
TEST PLUS **INSPECT** BIG HOLES



Access  
Panels

Drywall at  
Top Plate

Penetrations:

- Ceiling Fixtures
- Vents
- Plumbing



Chases

Cracks:

- Window Openings
- Door Openings
- Sill Plates

AIR SEALING

# BYPASS AT WALL/ATTIC INTERFACE



AIR SEALING

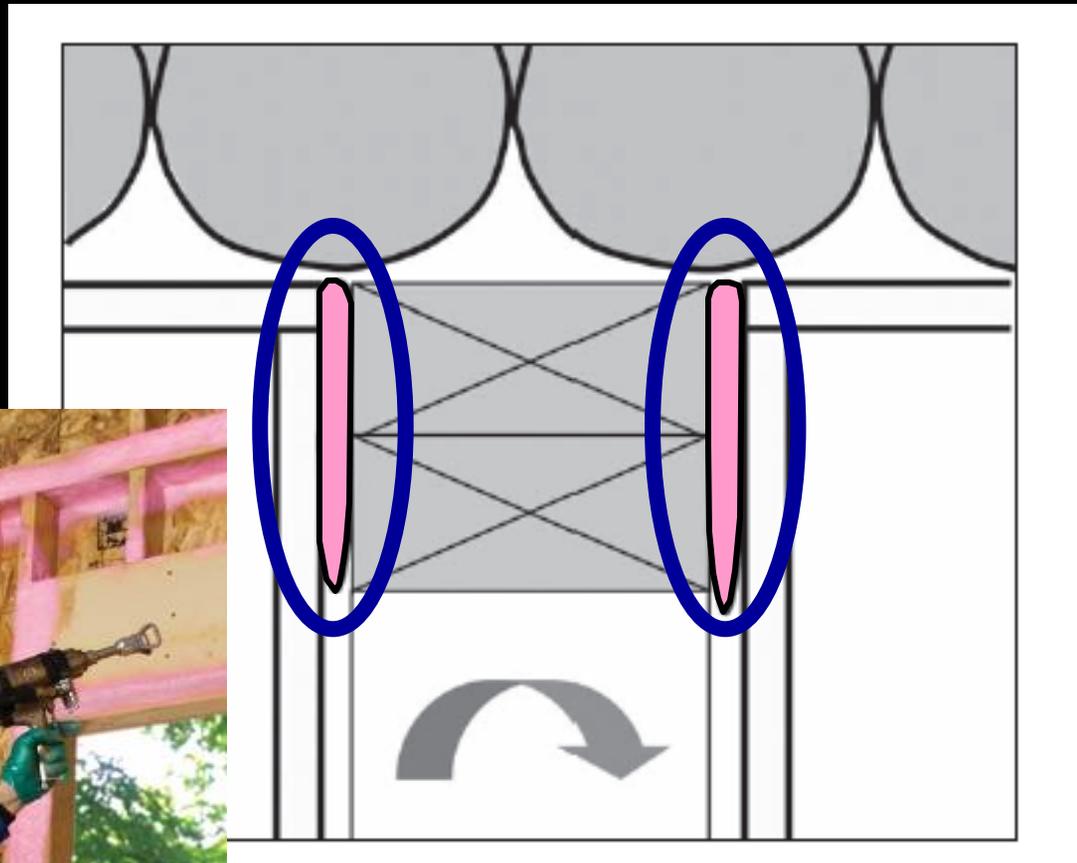
# WALL/ATTIC INTERFACE DETAIL



**Construction adhesive shall not be used.**



# AIR SEALING WALL/ATTIC INTERFACE DETAIL

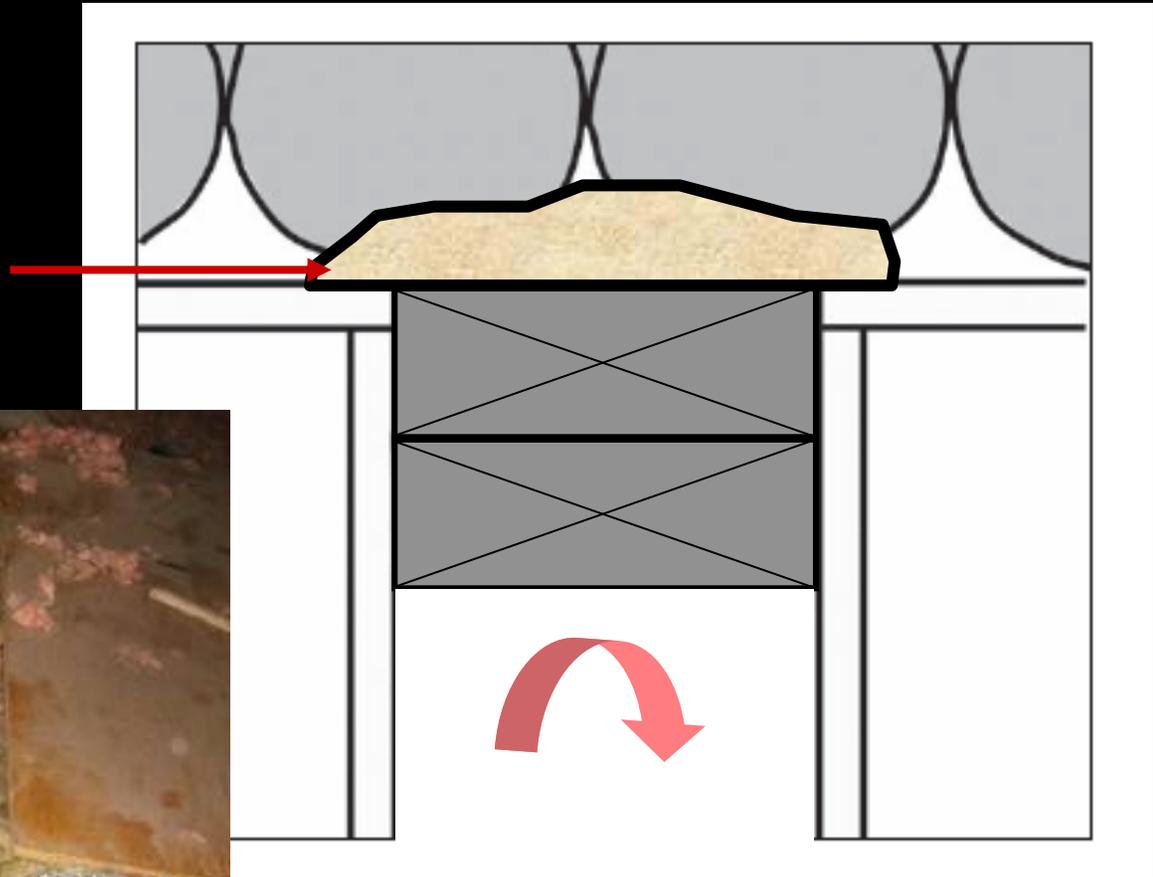


AIR SEALING

# WALL/ATTIC INTERFACE DETAIL



Foam seam  
between drywall  
and framing at top



BUILDING SCIENCE

# FIBROUS INSULATION $\neq$ AIR BARRIER



Resists Heat Flow



Air Flow

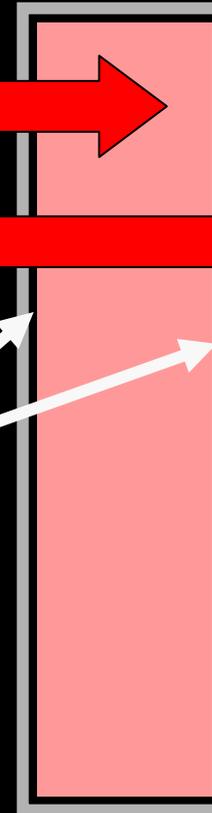


**...need Air Barrier...**

(any solid material that blocks air flow including sealing at edges and seams)

**...on all six sides...**

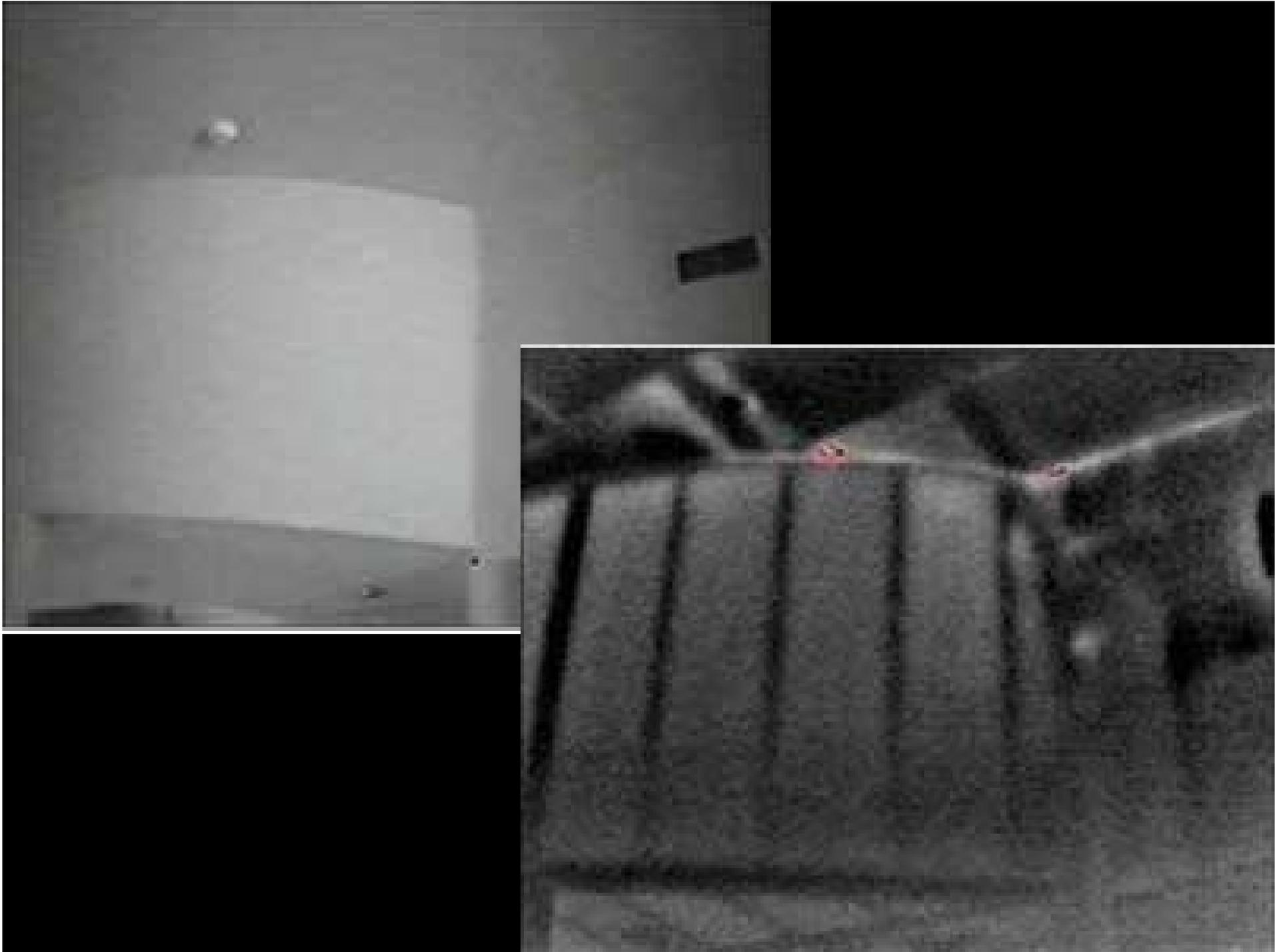
**...in direct contact with insulation (alignment)**

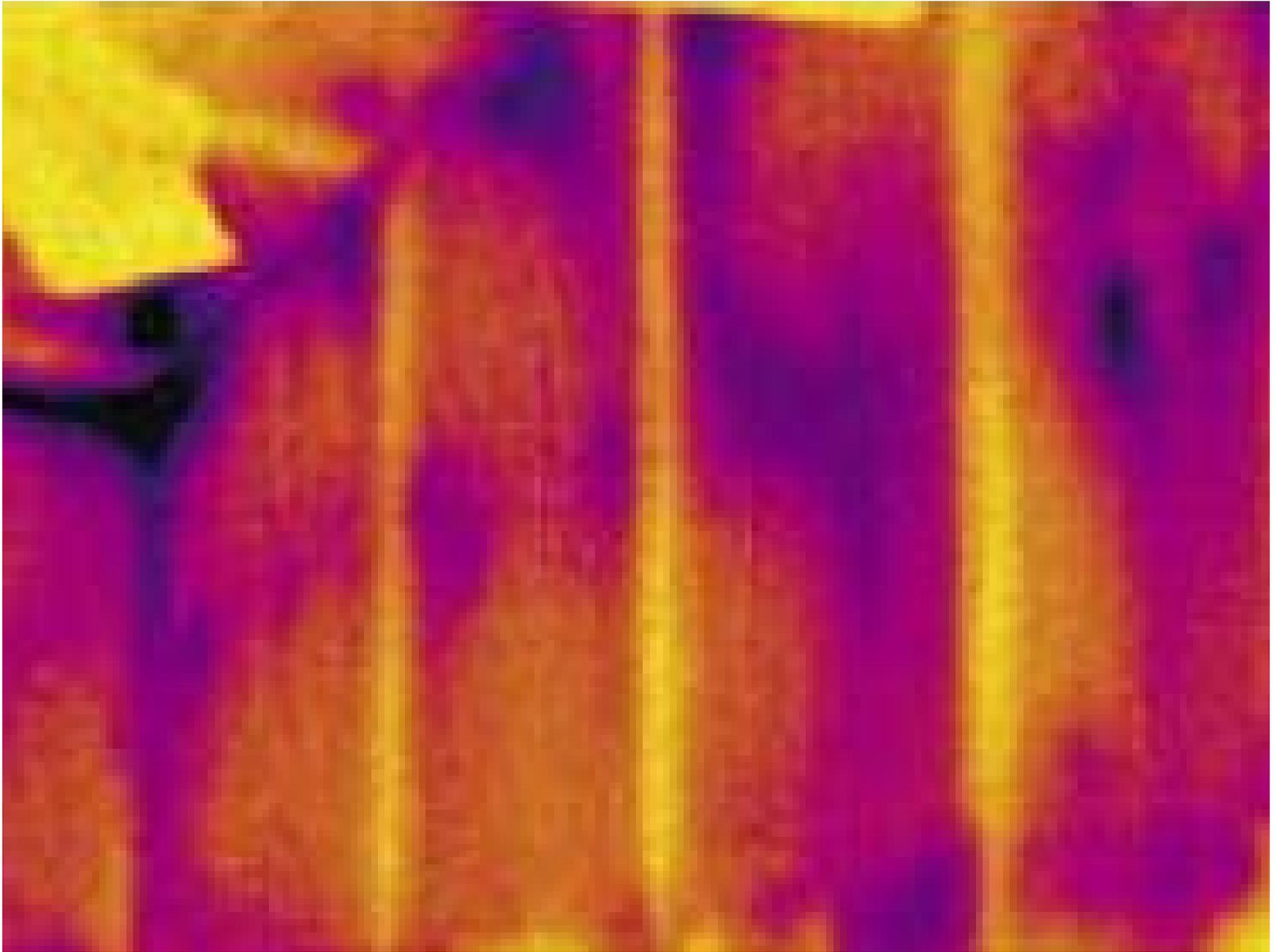


# AIR BARRIERS INSULATION IS NOT AN AIR BARRIER



Courtesy of  
Blue Grass  
Energy





AIR BARRIERS  
ATTIC KNEE WALLS



**Hot Wall**

Courtesy of Building Science Corp.

AIR BARRIERS

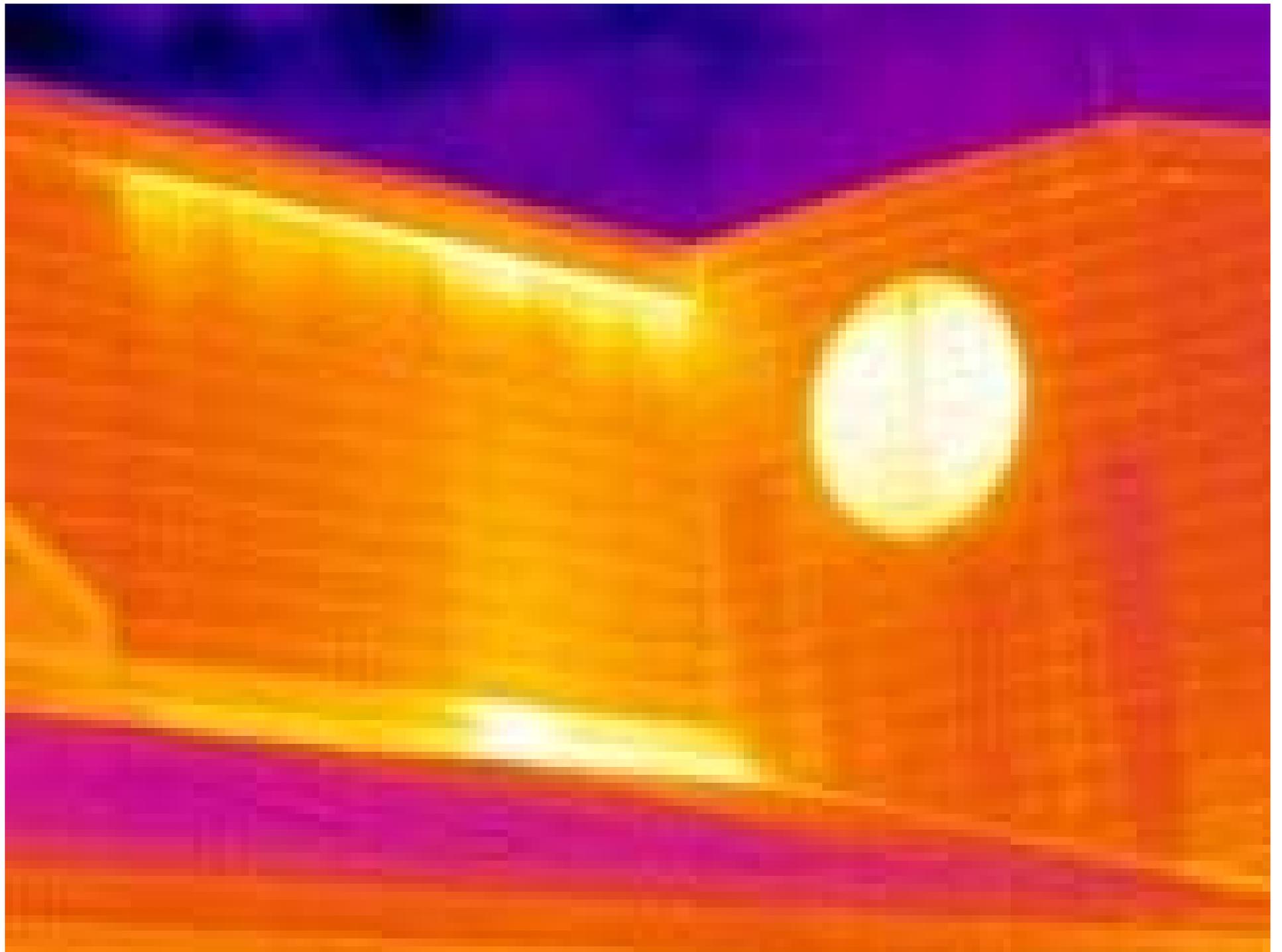
INSET STAPLING = MISALIGNMENT



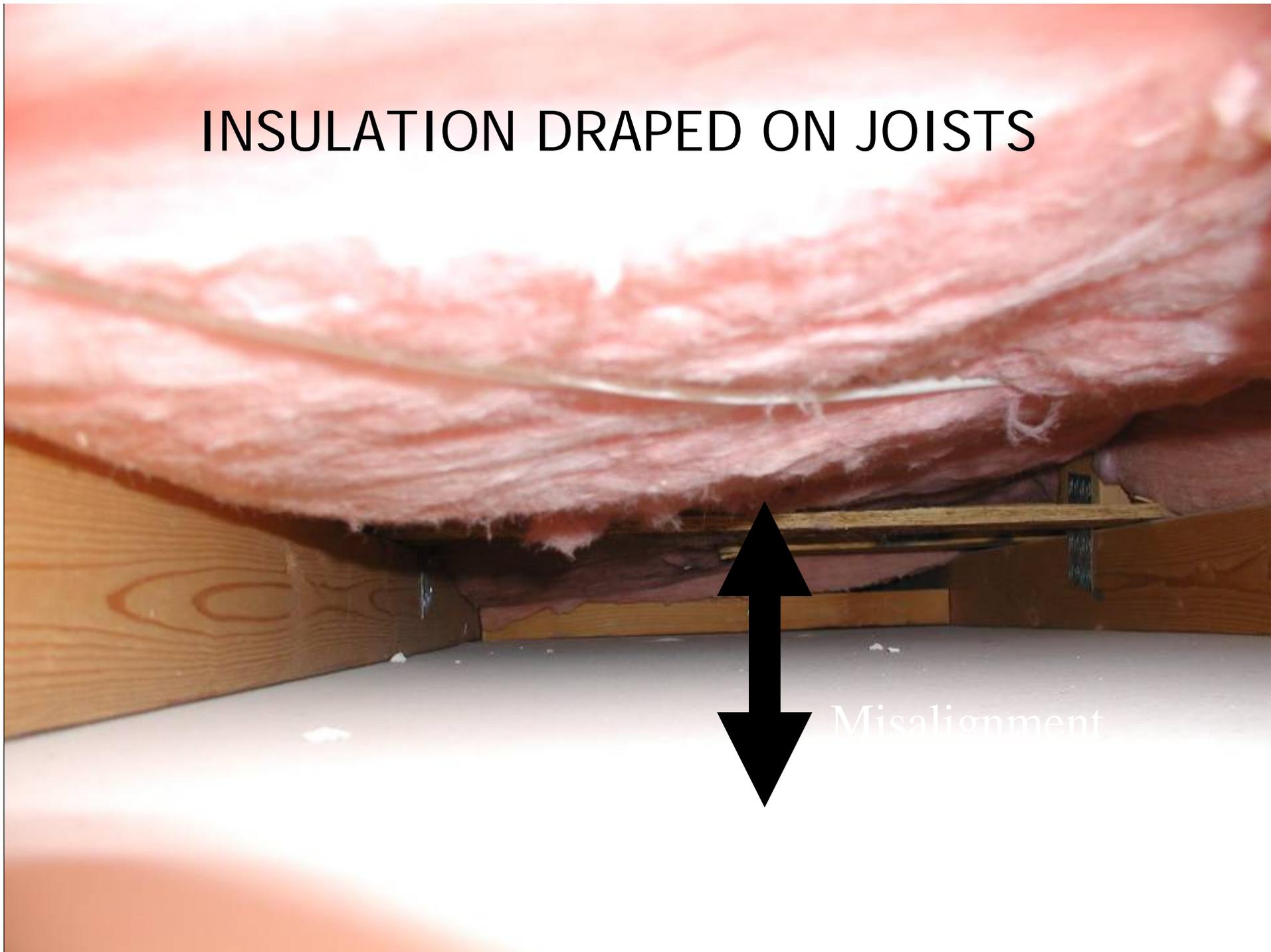
AIR BARRIERS

INSET STAPLING = MISALIGNMENT





# INSULATION DRAPED ON JOISTS

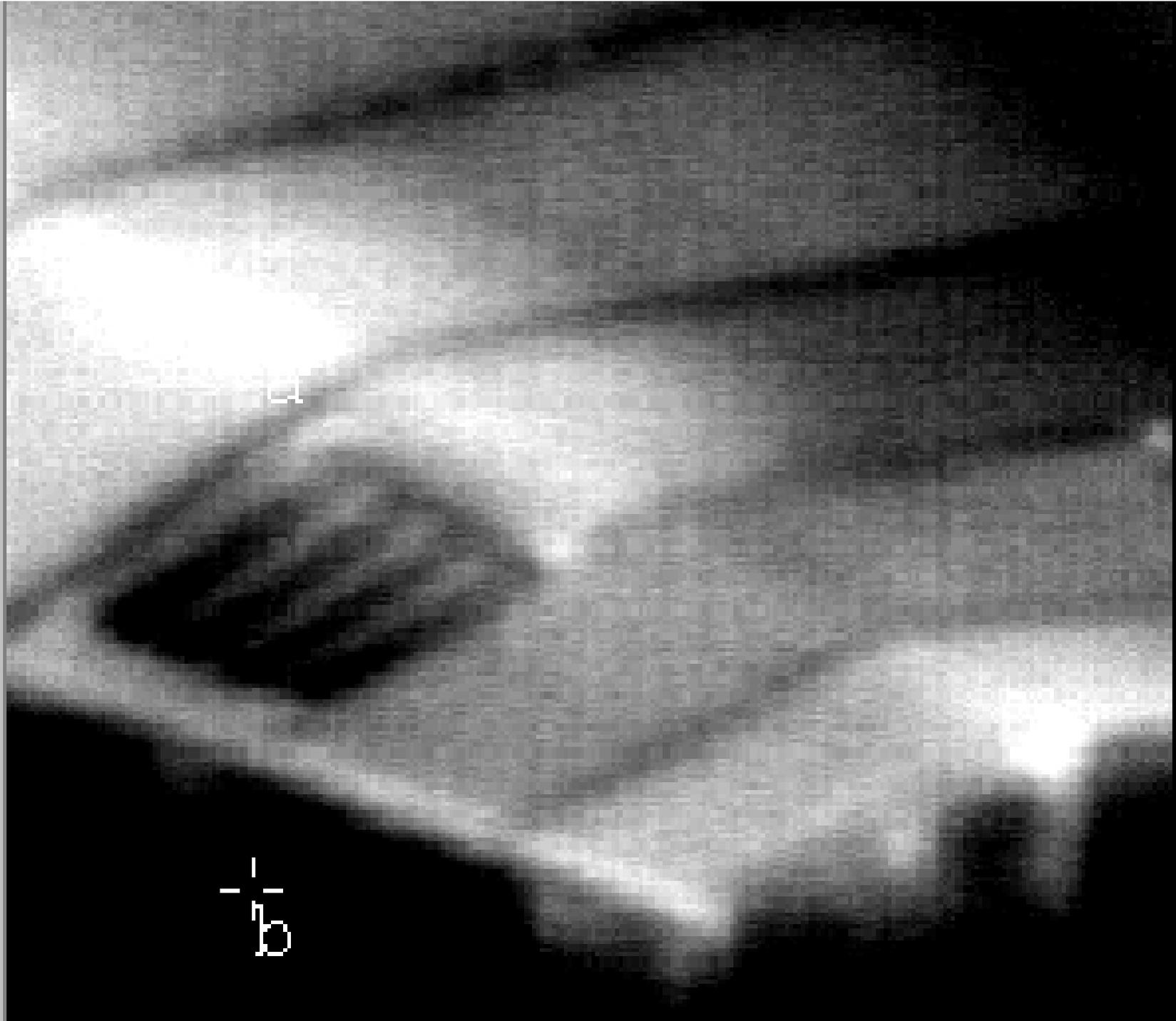


Misalignment

M. Point

a 97.3

b 89.0



$\frac{1}{b}$

( 14.0)

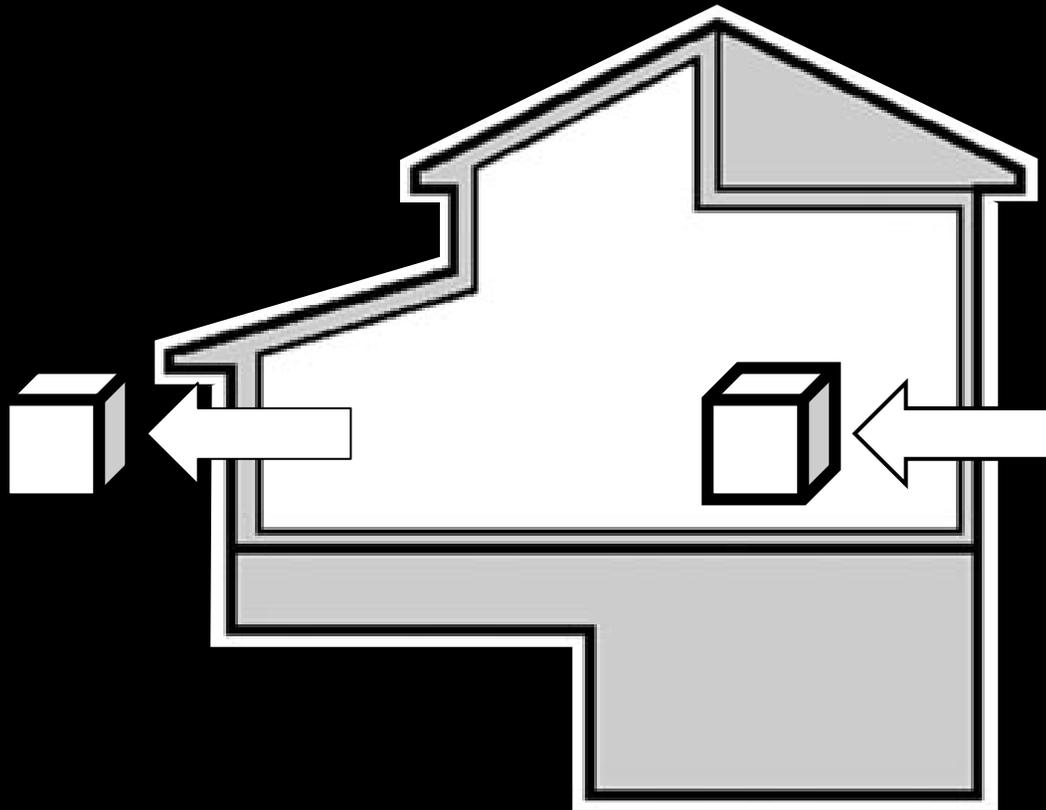
1. OVERALL AIR BARRIER/THERMAL BARRIER ALIGNMENT:  
PROBLEM: POOR ALIGNMENT



OVERALL AIR BARRIER AND THERMAL ALIGNMENT  
FURRED DOWN CEILING W/BATTS



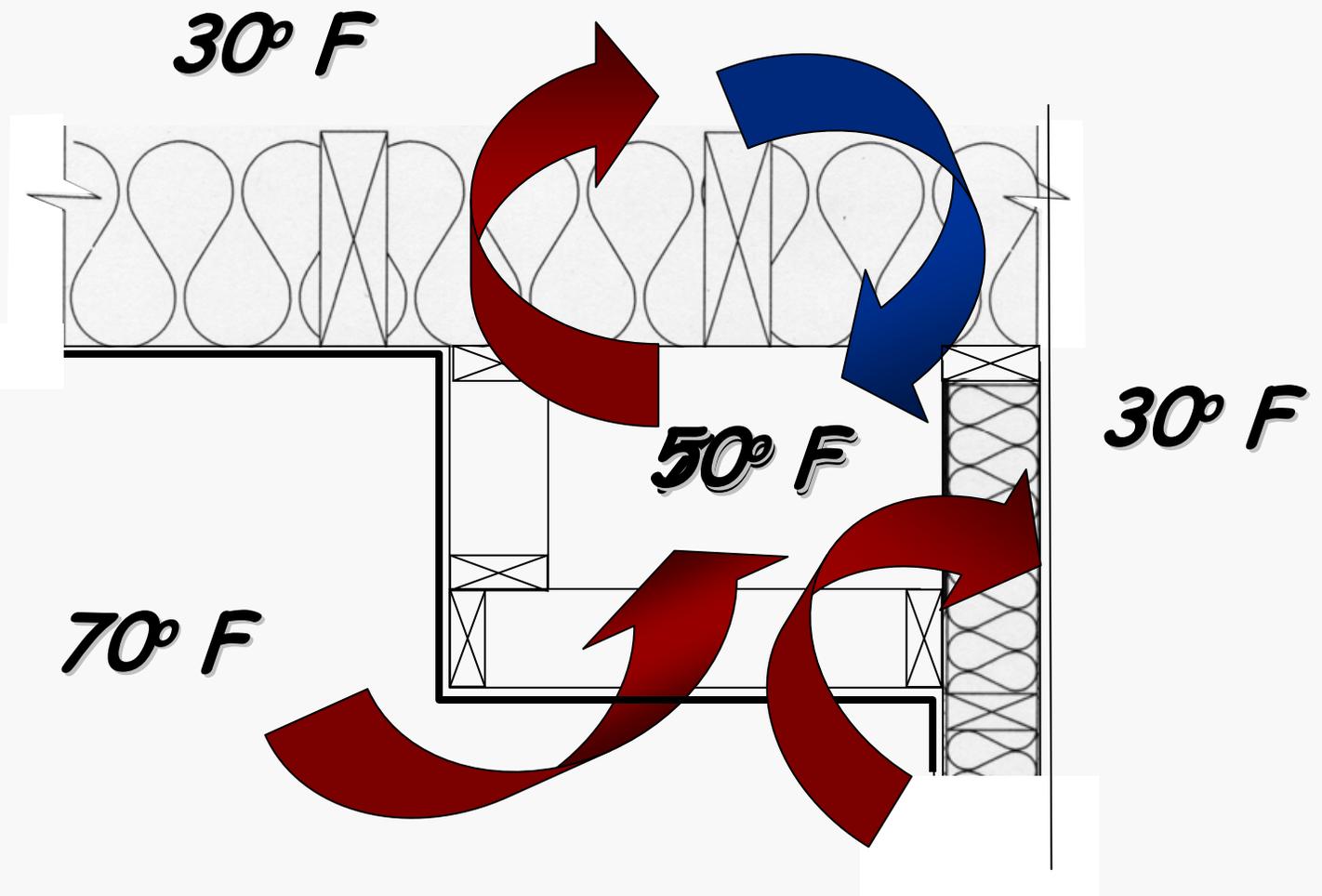
BUILDING SCIENCE  
ONE OUT = ONE IN





BUILDING SCIENCE

# WHY COMPLETE AIR BARRIER

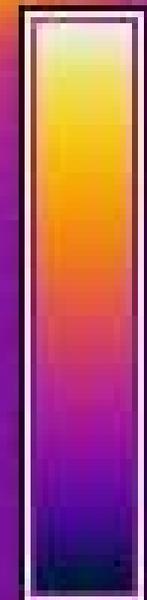
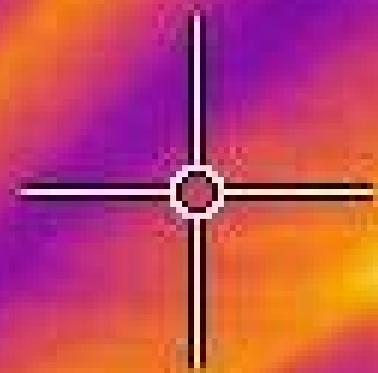




 FLIR

+ 50.1 °F

57



44

3/13/06 3:49:14 p e=0.90

# DROPPED CEILING



Courtesy of Building Science Corp.

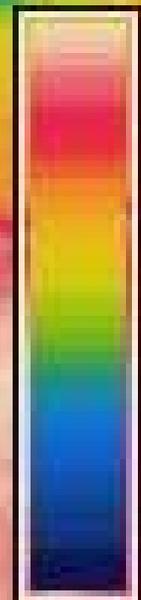
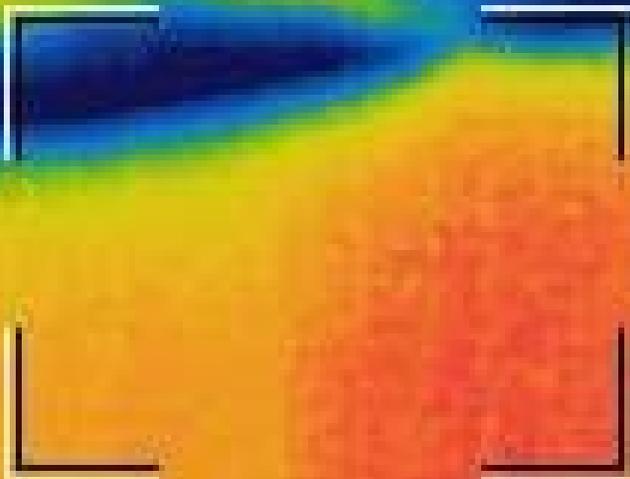


Wind intrusion, what's that?

 FLIR

X 62.9 °F

69



54

06-12-08 8:12:50 p e=0.97

( 392.0)

# Solution? Space age material



Perimeter radiant heating?  
No, wind intrusion.

91.4

89.9

88.4

86.9

85.4

83.9

82.4

80.9

79.4

# WIND BAFFLES AT EACH BAY





# ATTIC ACCESS PANEL PROBLEM



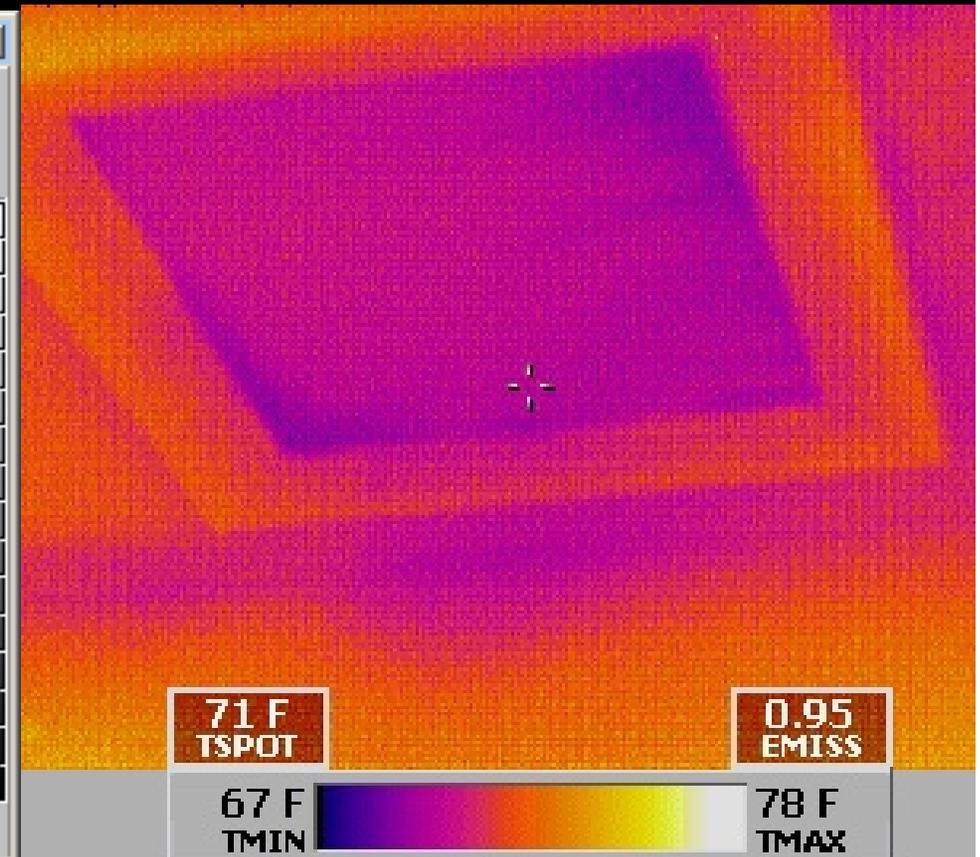
CH1: MA510047.TMP TH5104

RG:1 E:0.94 SC:NORM

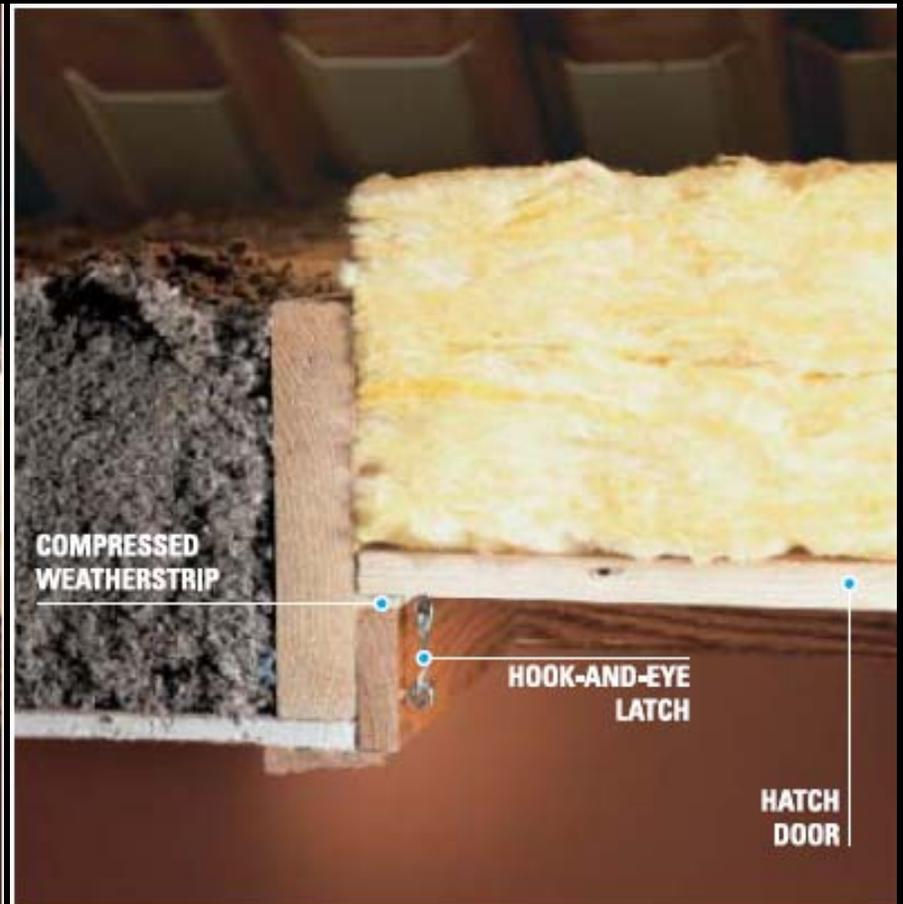
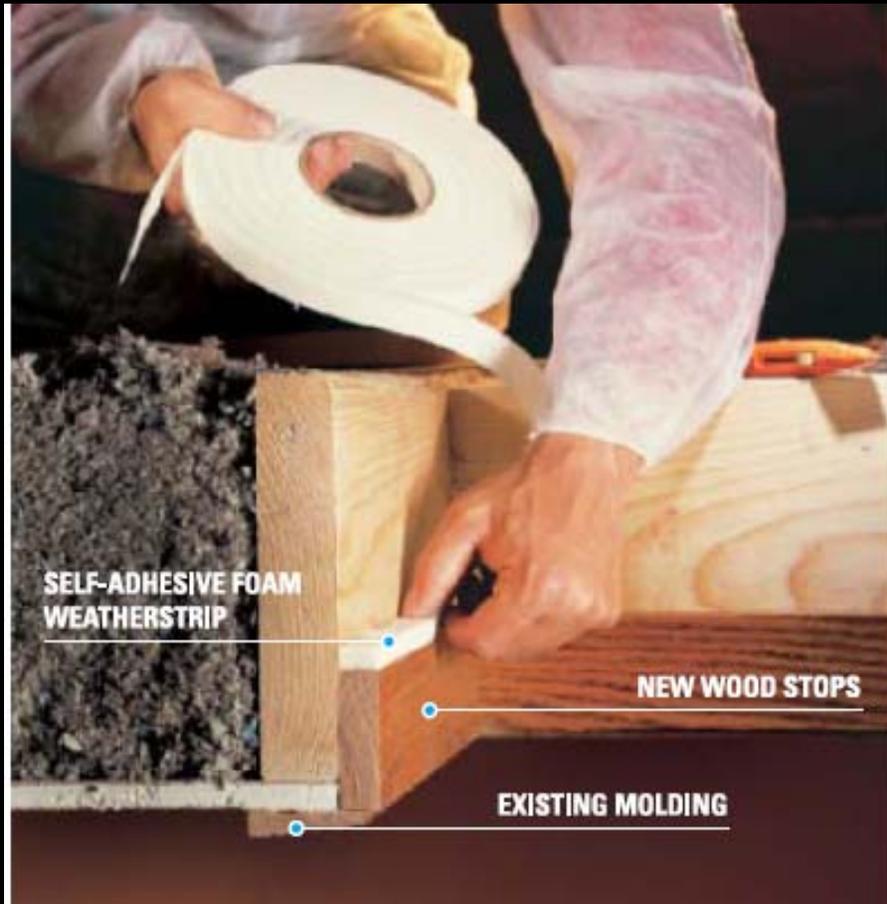
02/07/02  
13:38:11  
( 392.0)



87.3  
86.3  
85.3  
84.3  
83.3  
82.3  
81.3  
80.3  
79.3  
( 14.0)

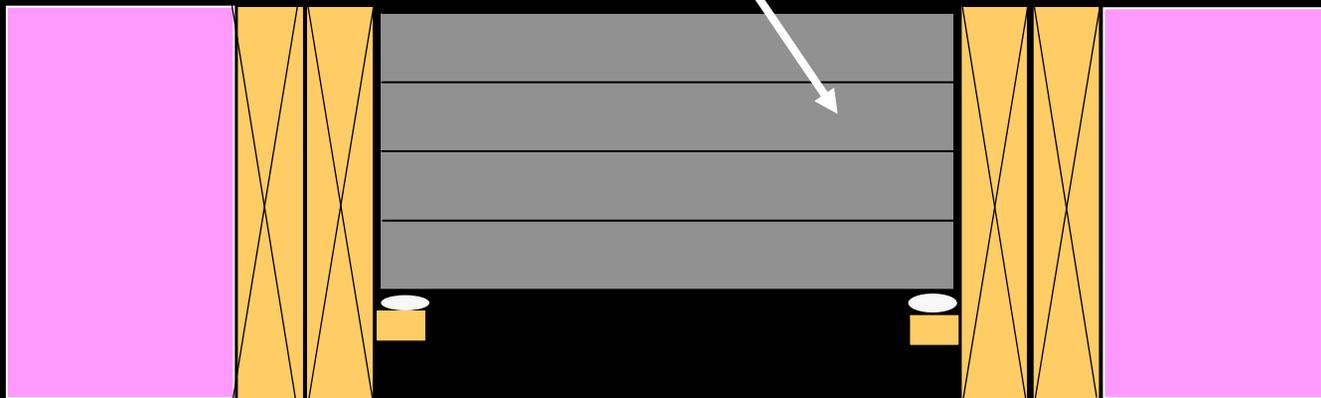


# ATTIC ACCESS PANEL SOLUTION



# ATTIC ACCESS PANEL SOLUTION

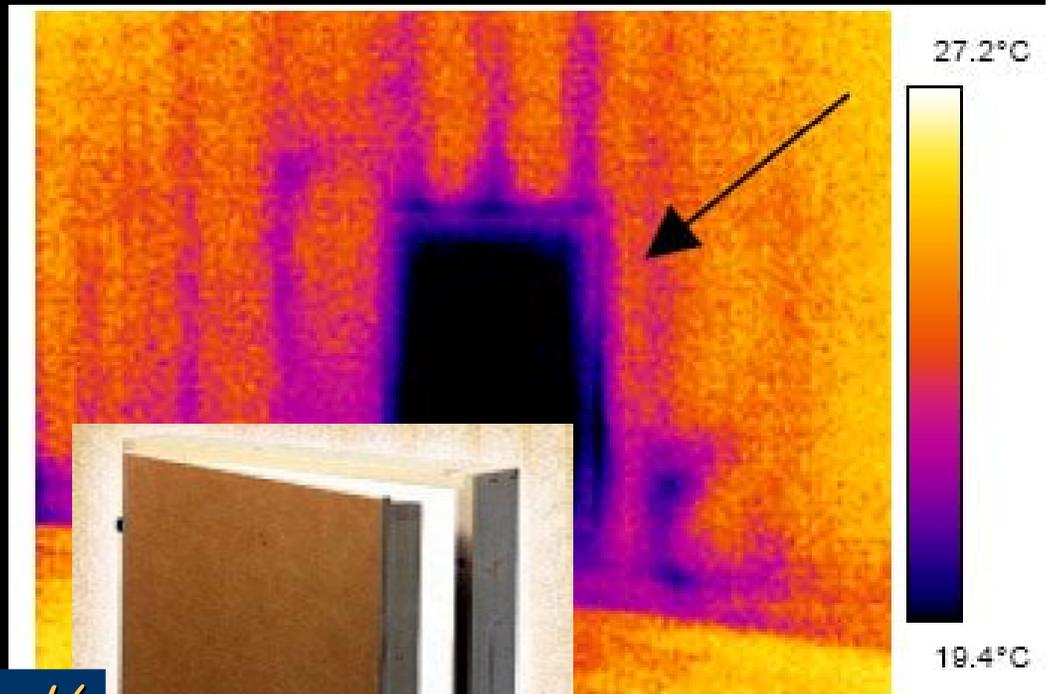
Multiple layers of  
rigid insulation



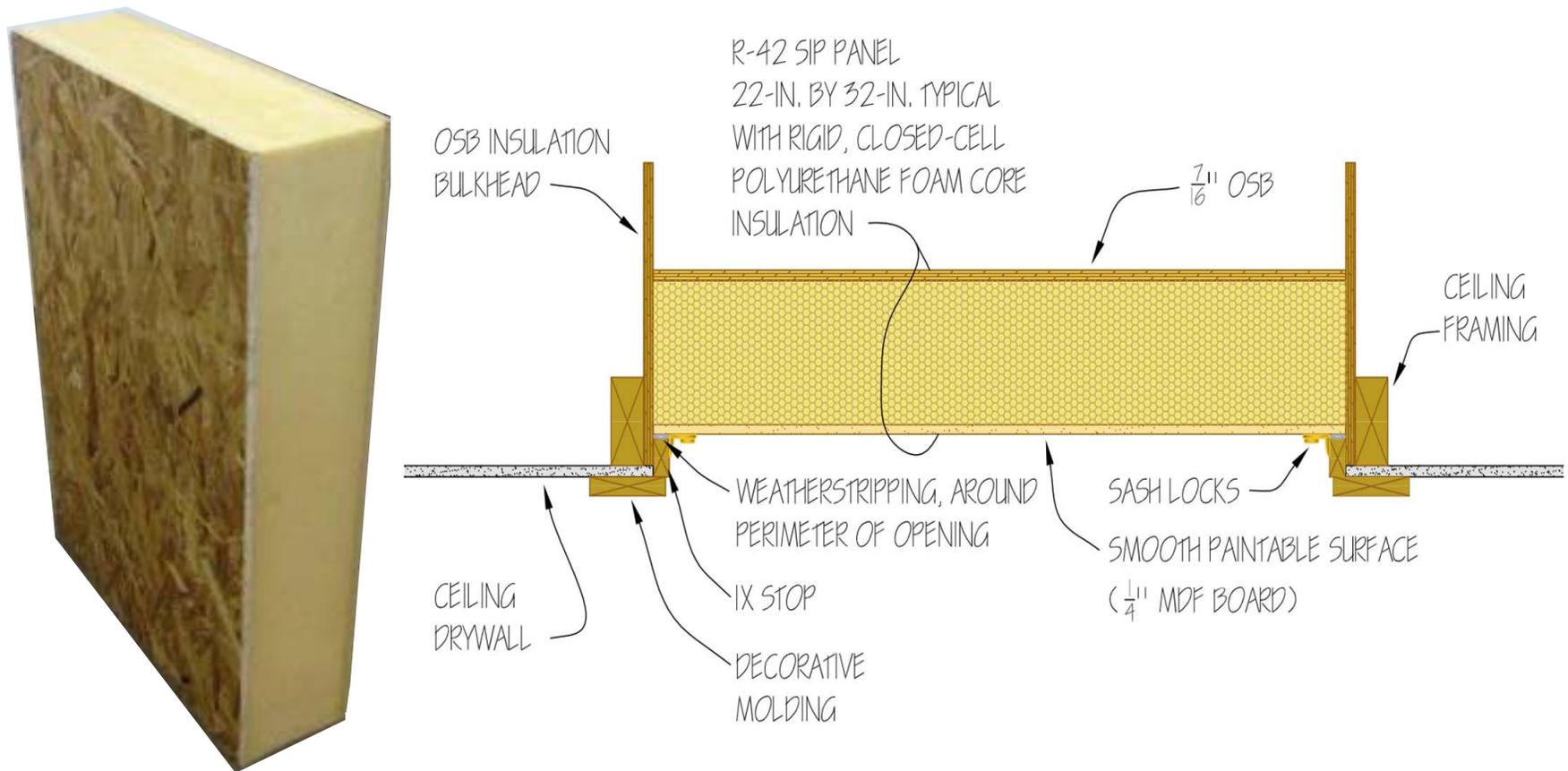
# ATTIC ACCESS DOOR



*Insulated/  
Gasketed  
Door*



# ATTIC ACCESS PANEL SOLUTION



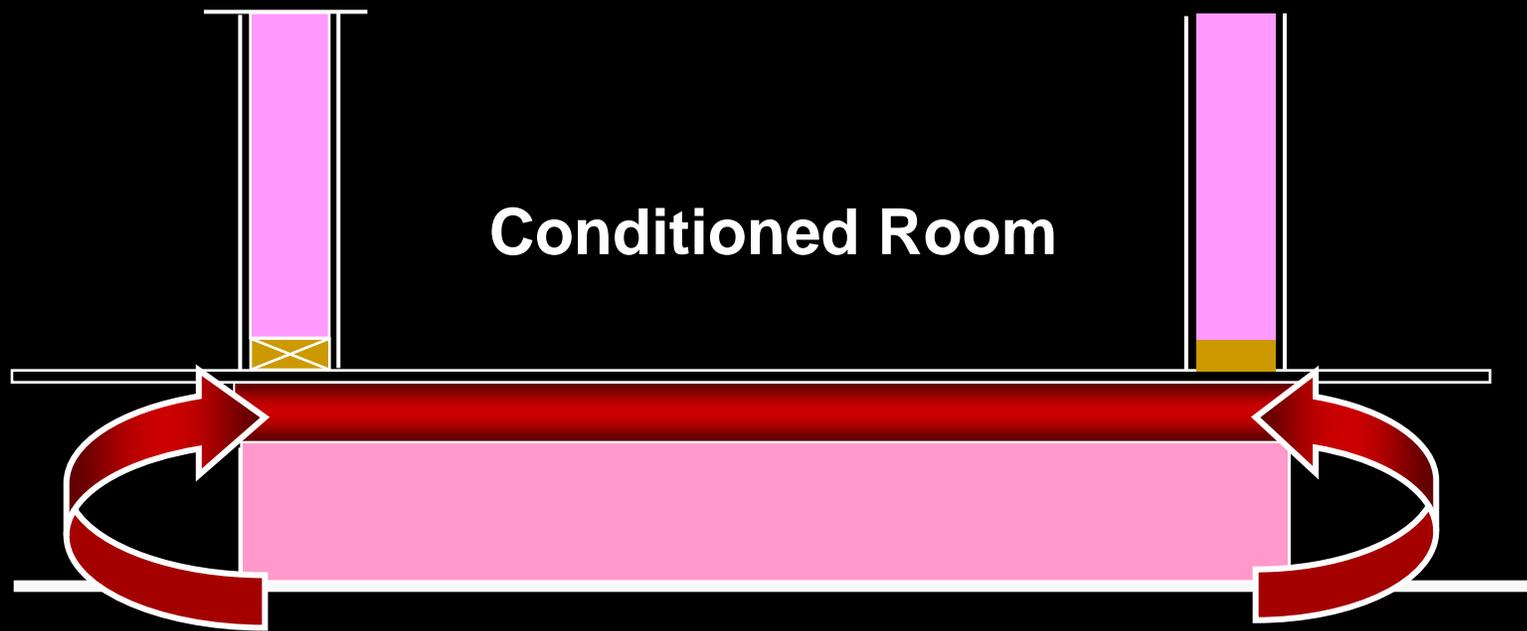
Source: Insulated Component Structures

AIR BARRIERS  
GRAVITY MAKES THINGS FALL...  
EVEN INSULATION



AIR BARRIERS

# GARAGE/CANTILEVER FLOOR



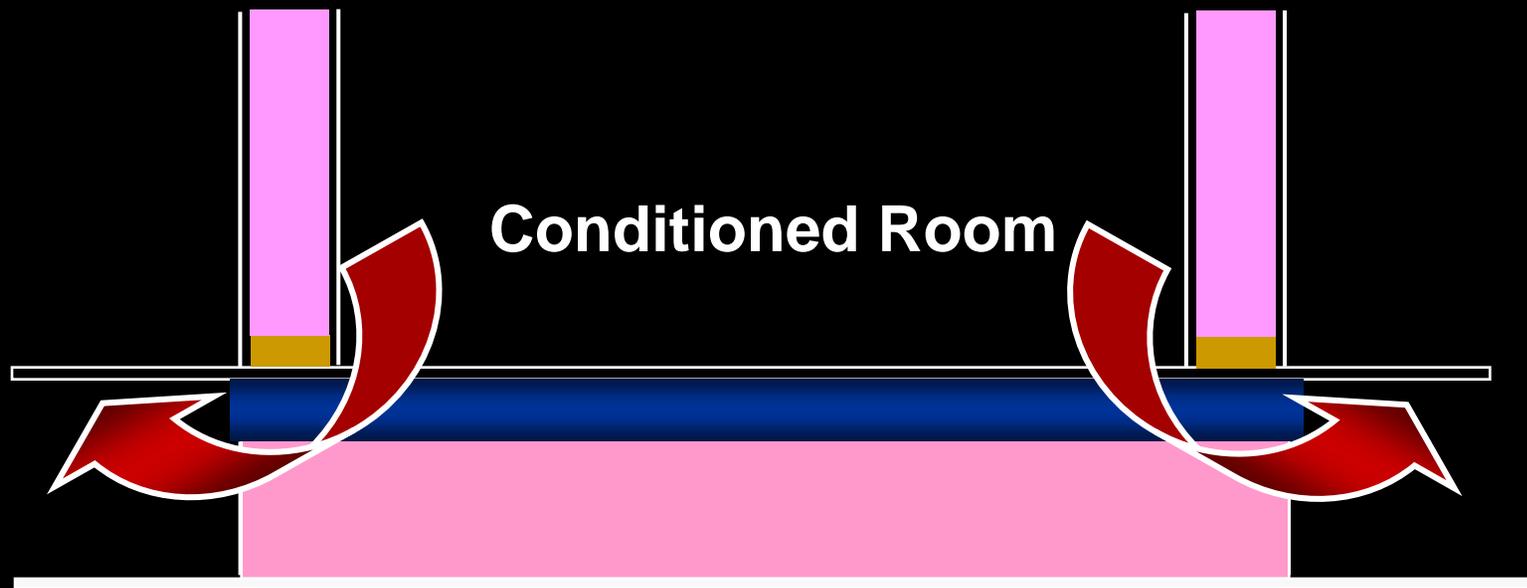
Conditioned Room

Garage Ceiling

Summer

AIR BARRIERS

# GARAGE/CANTILEVER FLOOR



Conditioned Room

Garage Ceiling

Winter

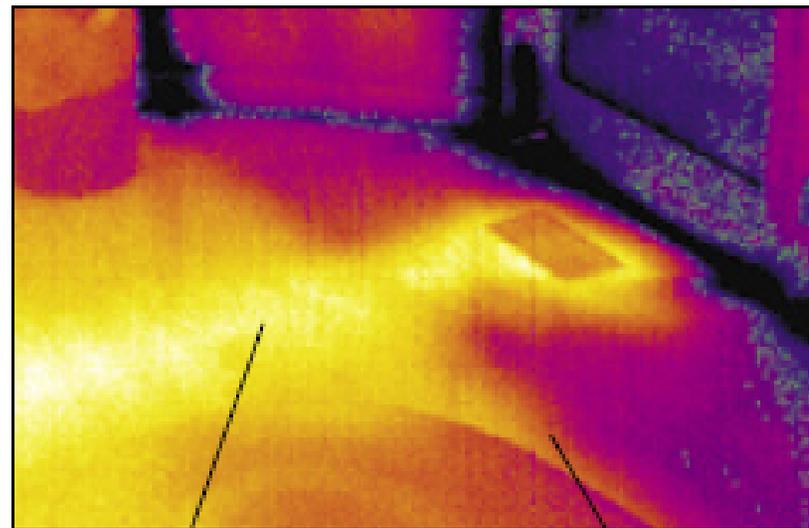


# AIR BARRIERS CANTILEVERED FLOOR PROBLEM



Exterior soffit appeared to be tightly fit

As the infrared photo (right) shows, this dining room cantilever was cold due to ineffective insulation and air leakage. (Infrared photo taken with blower door operating.)



Residual warmth from heat run

Cantilever boundary clearly visible

# AIR BARRIERS INSULATED FLOOR SOLUTION



AIR BARRIERS

SPRAY FOAM GARAGE CEILING



# INSULATION INSTALLATION PROBLEM



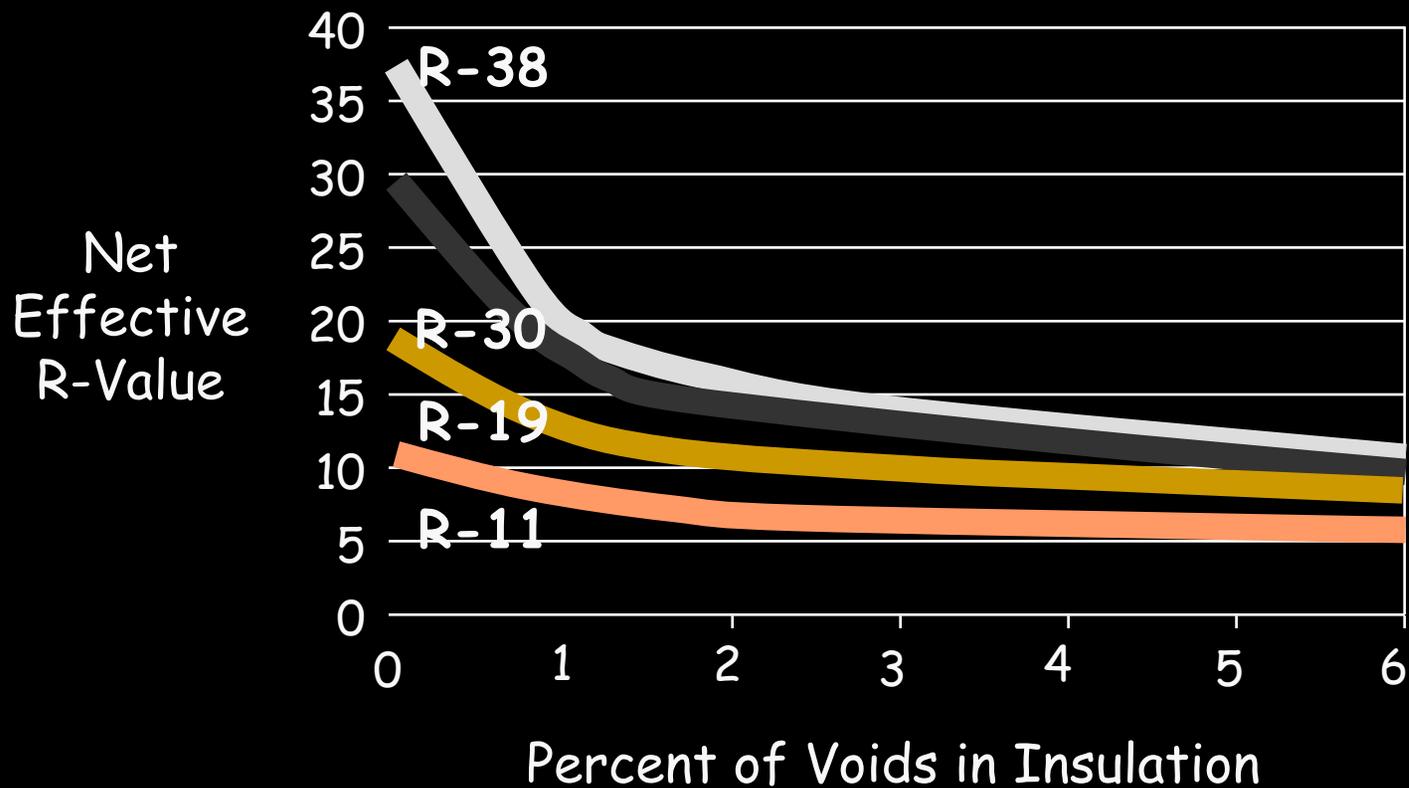
**Void**

**Gap**

**Compression**

**Misalignment**

# EFFECT OF GAPS AND SPACES ON BATT INSULATION EFFECTIVENESS



Source: Insulate and Weatherize by Bruce Harley, 2002

CH1: MA510015.TMP TH5104

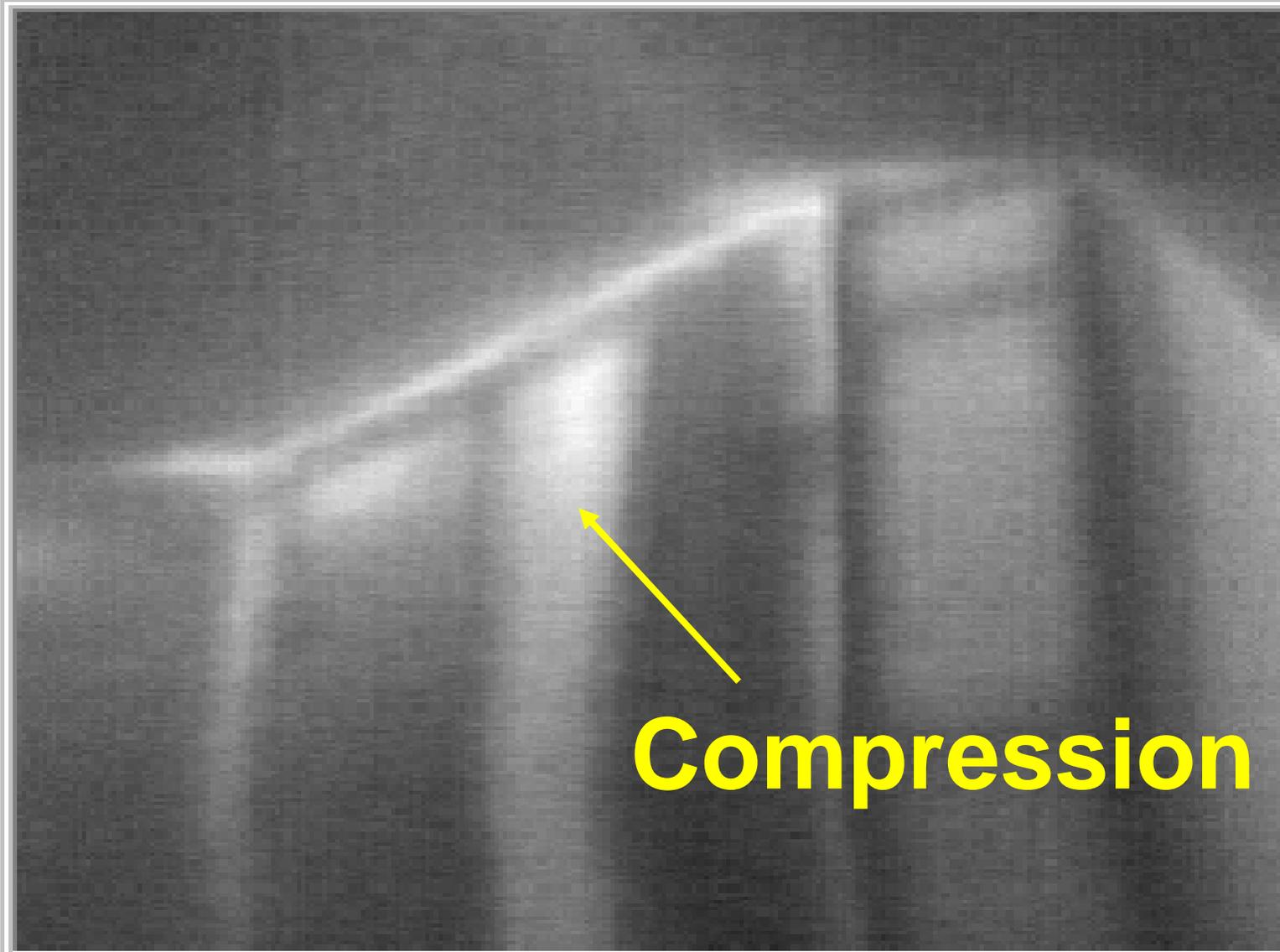


RG:1 E:0.94 SC:NORM

02/06/13

15:30:27

( 392.0)



( 14.0)

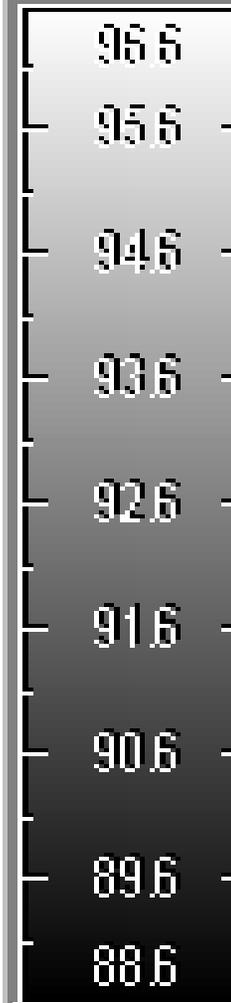
CH1: MA510019.TMP TH5104

RG:1 E:0.94 SC:NORM

02/06/13

15:36:41

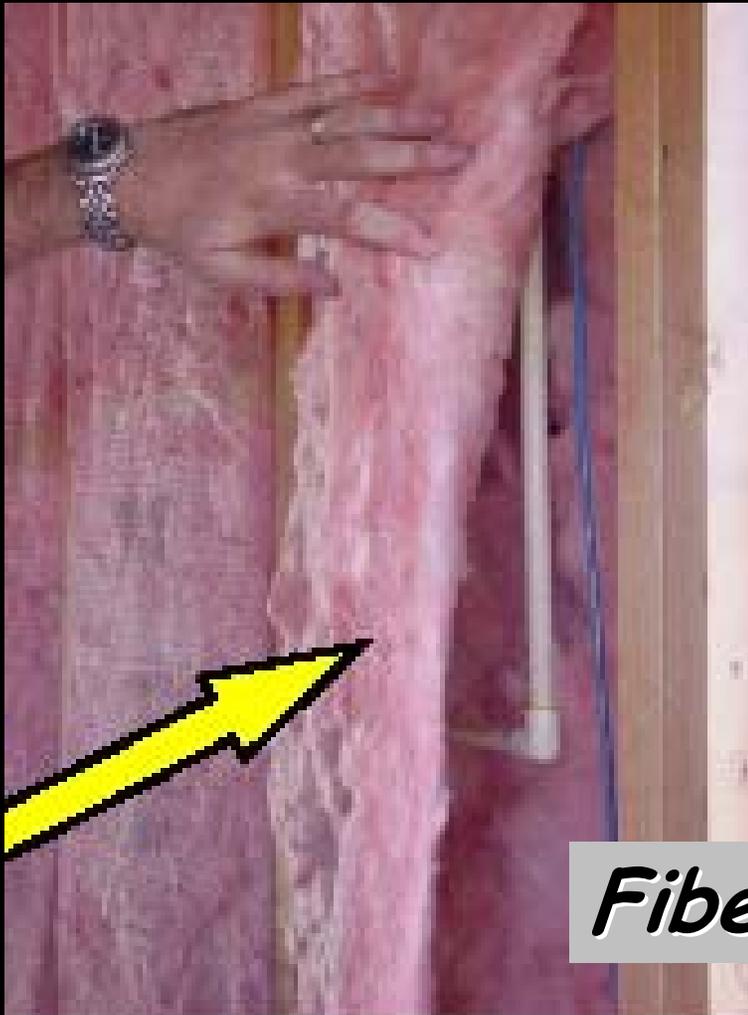
( 392.0)



( 14.0)

**Will be there for the  
life of the building!**

# PROPERLY INSTALLED INSULATION BATT INSULATION



*Fiberglass*



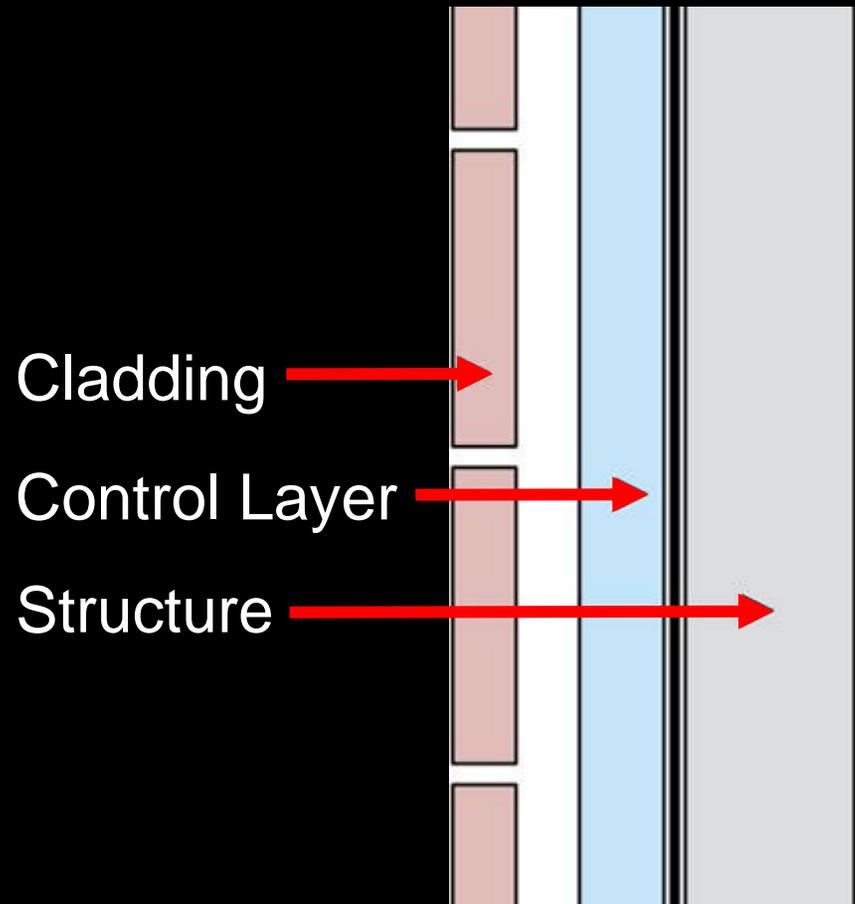
# PROPERLY INSTALLED INSULATION BLOWN-IN INSULATION



# PROPERLY INSTALLED INSULATION SPRAY FOAM



# PROPERLY INSTALLED INSULATION EXTERIOR RIGID INSULATION



**“The perfect wall”**

Joe Lstiburek,  
Building Science Corp.

# INSULATION INSTALLATION BAND JOIST INSULATION PROBLEM

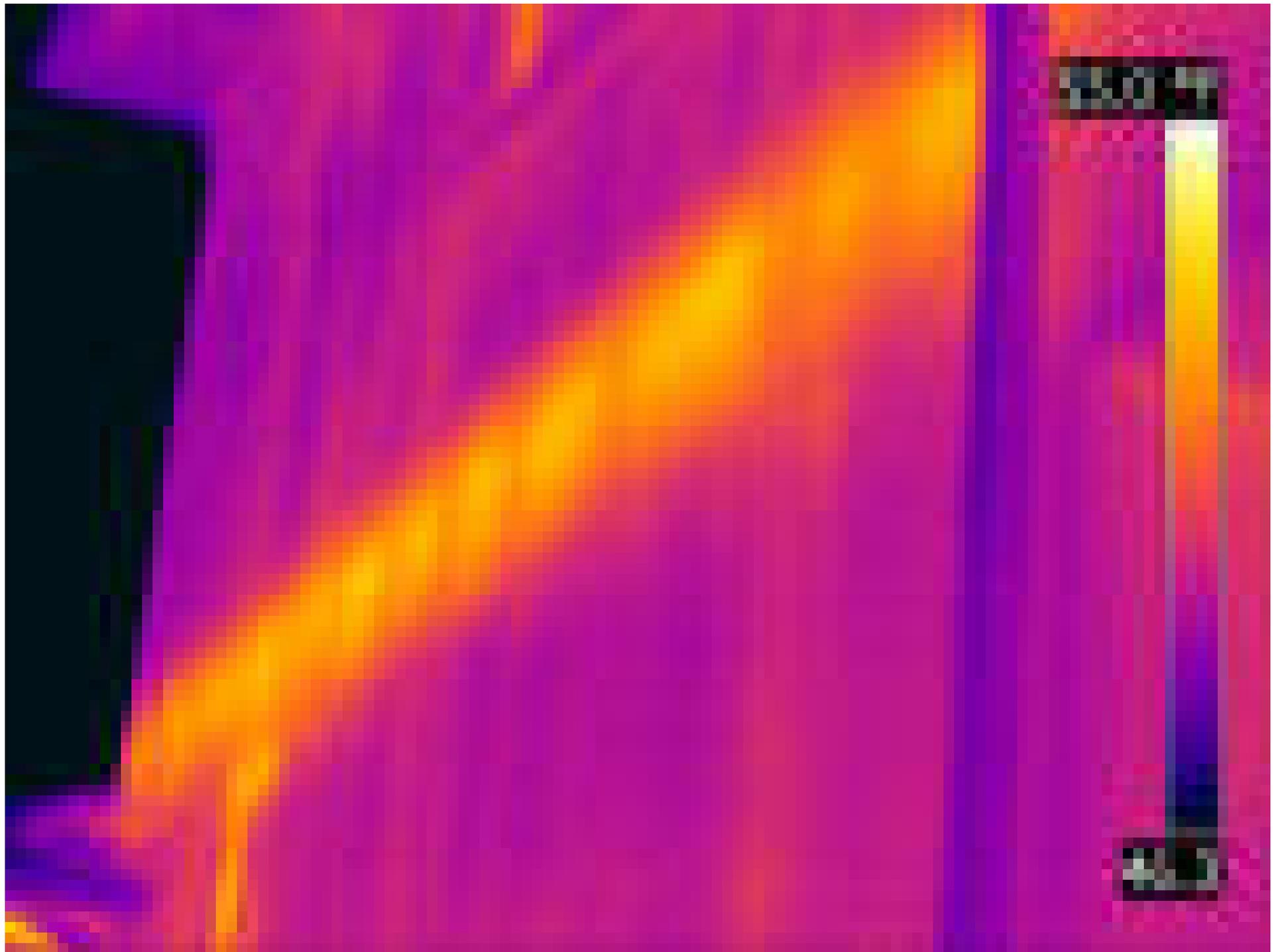


Misalignment

Gaps

Compression

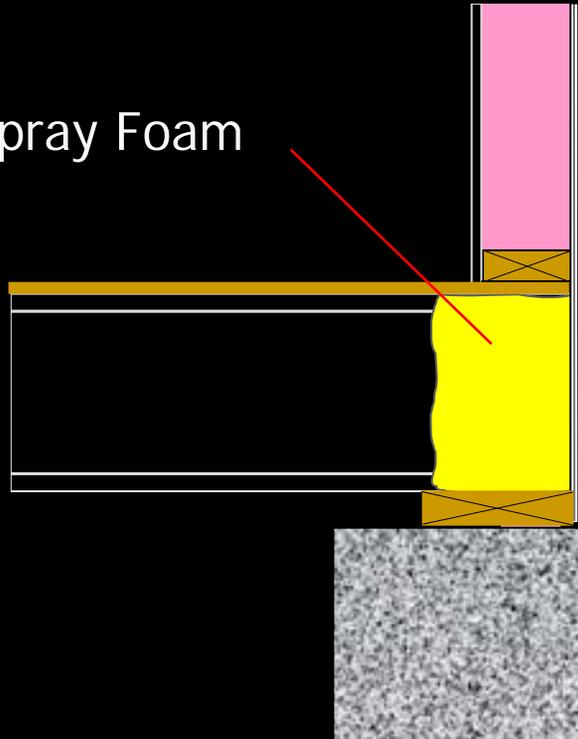
Voids



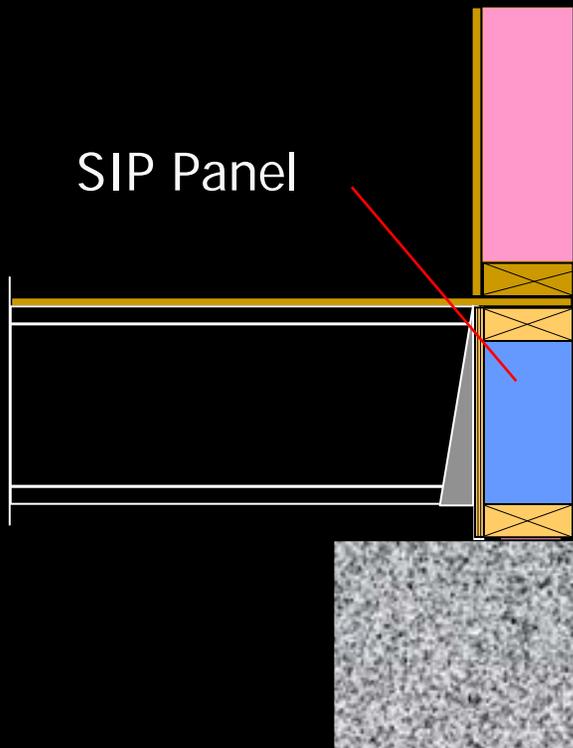
# INSULATION INSTALLATION BAND JOIST INSULATION SOLUTION



Spray Foam



# INSULATION INSTALLATION BAND JOIST INSULATION SOLUTION



SIP Panel

EMERCOR

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## Floors

### ► Insulated Rimboard

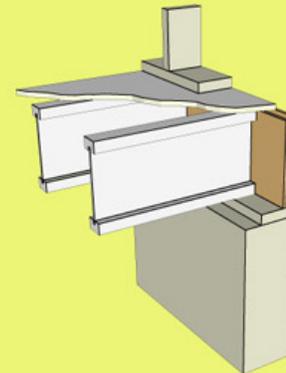
Cantilever Soffit  
Insulated Panels

### Exterior Walls

Foundation & Basement  
Walls

### Cathedral Ceilings & Attics

Bonus Rooms



## Insulated Rimboard

*The Quick & Easy Way To Insulate The Floor Perimeter*

EMERCOR's Insulated Rimboard is an integral part in building a better home, delivering comfort, health and energy efficiency to homeowners. Accounting for up to 14 per cent of a homes total air infiltration, the Insulated Rimboard eliminates air leakage and enables proper workmanship during installation. Truly a time saving material, the Insulated Rimboard turns a three-step process into one easy and sure way to install insulation at the floor system.

[Advantages](#)  
[Load Table](#)  
[Specifications](#)

[Brochure](#)   
[Installation Guide](#)

### Advantages

#### Energy Efficient - R 14:

Up to 14 per cent of total home air leakage occurs around the rim joist. EMERCOR's Insulated Rimboard decreases air leakage by ensuring that continuous R-14 insulation is placed around the floor perimeter.

#### Easy Installation - 20% Faster Install:

EMERCOR's Insulated Rimboard has a unique joining detail and installs up to 20 per cent faster than regular Rimboard. It also eliminates the nightmare of trying to insulate and seal around every floor joist.

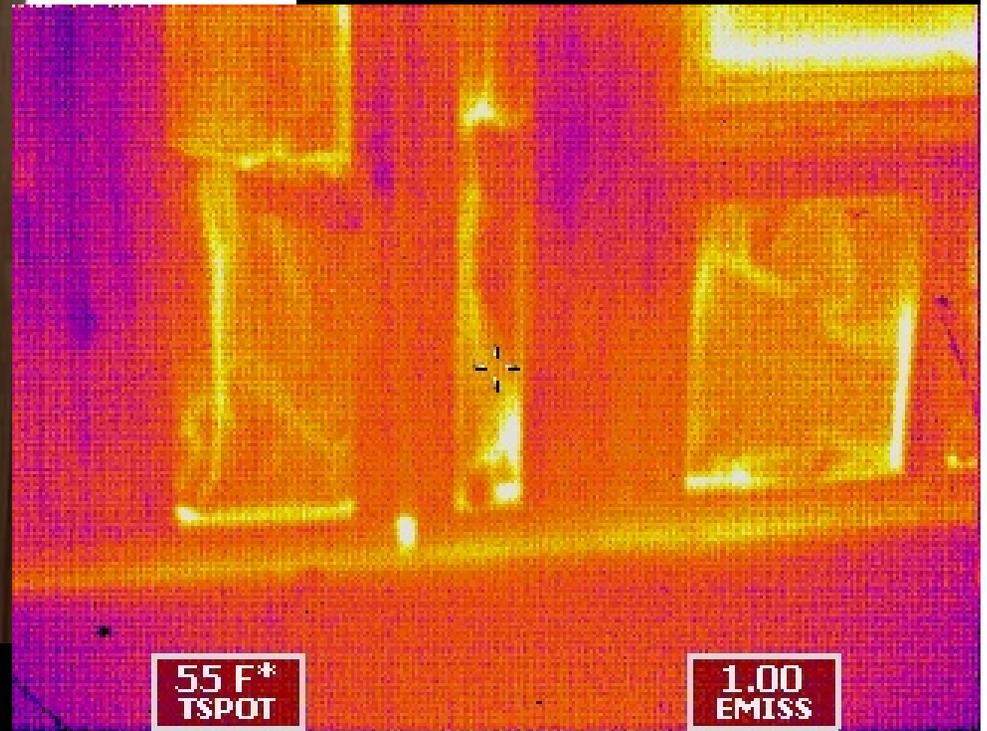
#### Moisture Resistant - Type 1 Vapor Barrier:

EMERCOR's Insulated Rimboard has a vapor permeance of less than one, making it a Type 1 vapor barrier. This barrier prevents moisture condensation in the building envelope which leads to rot, mold and eventually structural damage.

#### Environmental - Reduce job site waste:

EMERCOR's Insulated Rimboard is engineered with a unique joining detail. This joining detail allows traditionally discarded pieces to be reused along the floor perimeter. EMERCOR's commitment to sustainability is driven through the 'EMERGreen Program', with an internal focus on implementing lean in both their manufacturing and office facility.

# THERMAL BRIDGING FRAMING PROBLEM



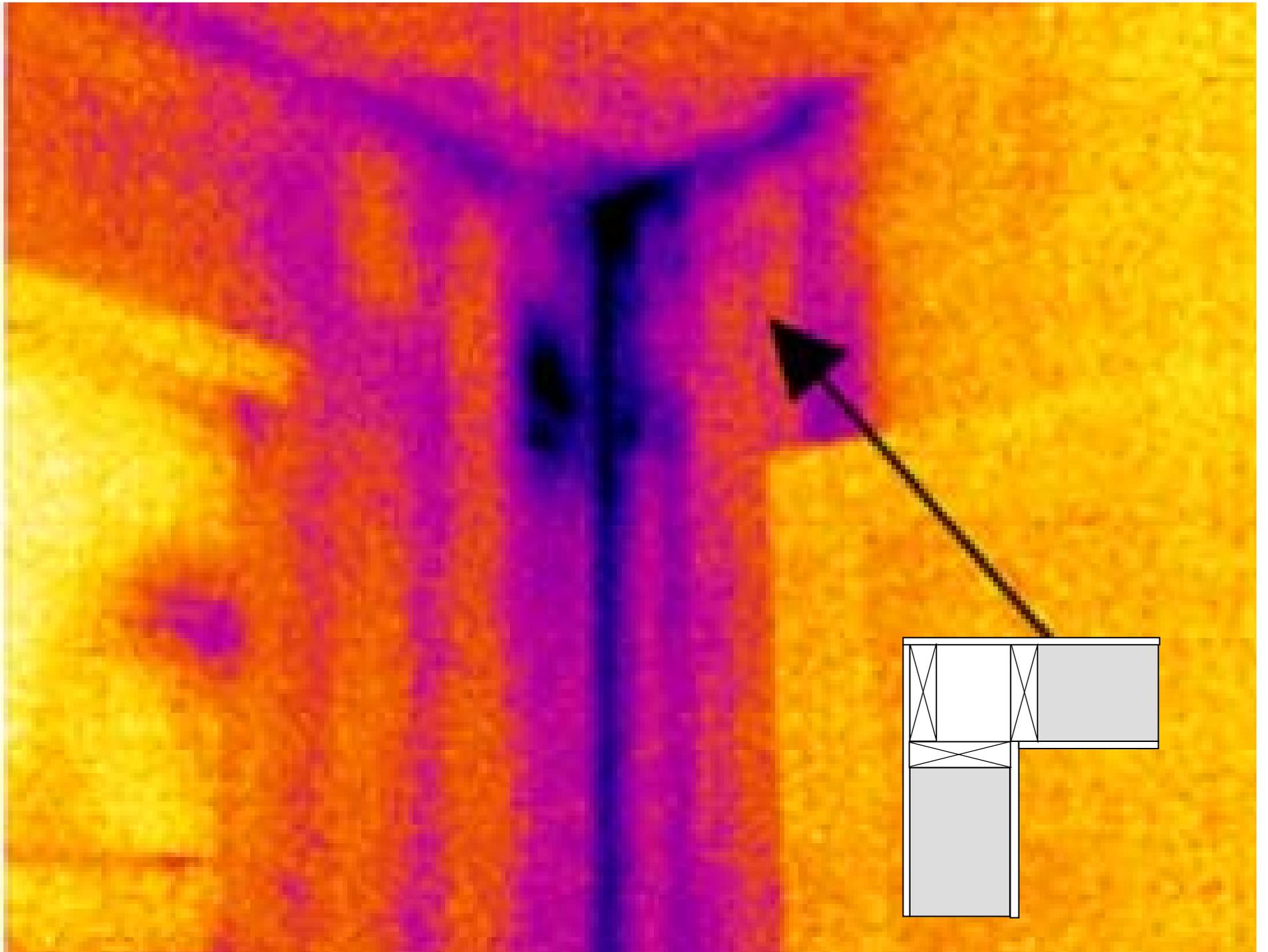
55 F\*  
TSPOT

1.00  
EMISS

53 F  
TMIN



64 F  
TMAX



# THERMAL BRIDGING ADVANCED FRAMING: CORNERS

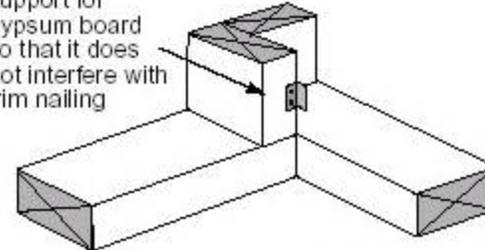


Courtesy of Building Science Corp.

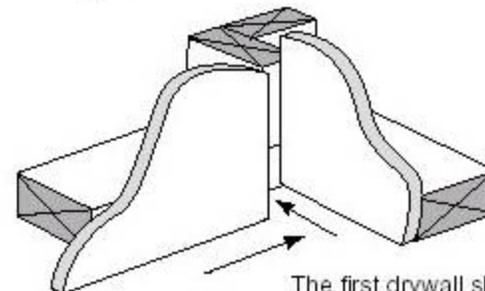
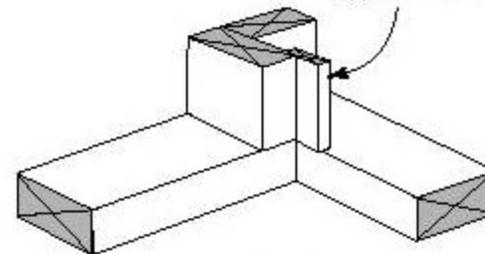
Courtesy of Southface Institute

## INSIDE "TWO-STUD" CORNERS

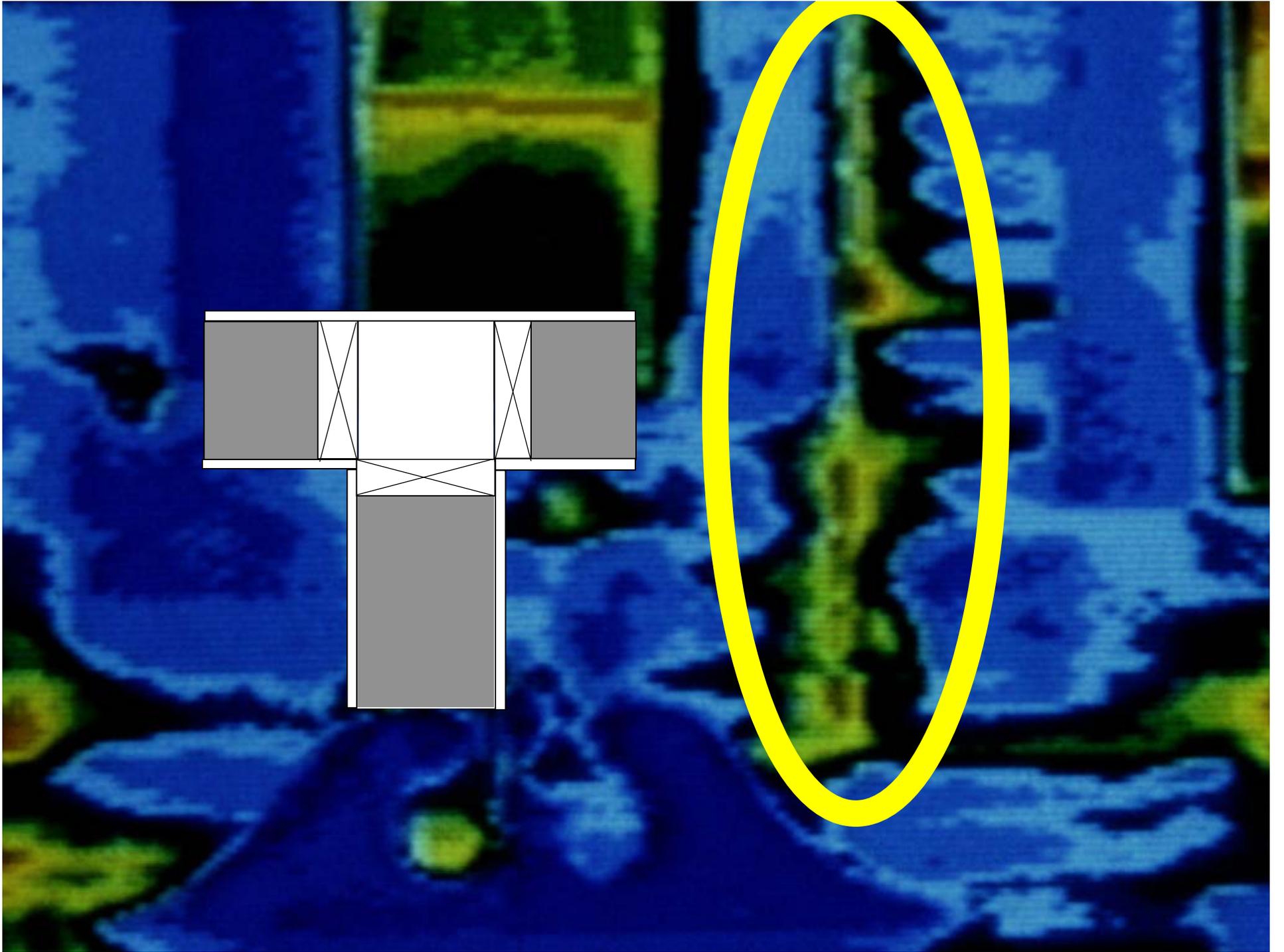
Position clip support for gypsum board so that it does not interfere with trim nailing



Backer support for gypsum board



The first drywall sheet is installed against side with clip or backer



THERMAL BRIDGING

## ADVANCED FRAMING: WALL INTERSECTIONS

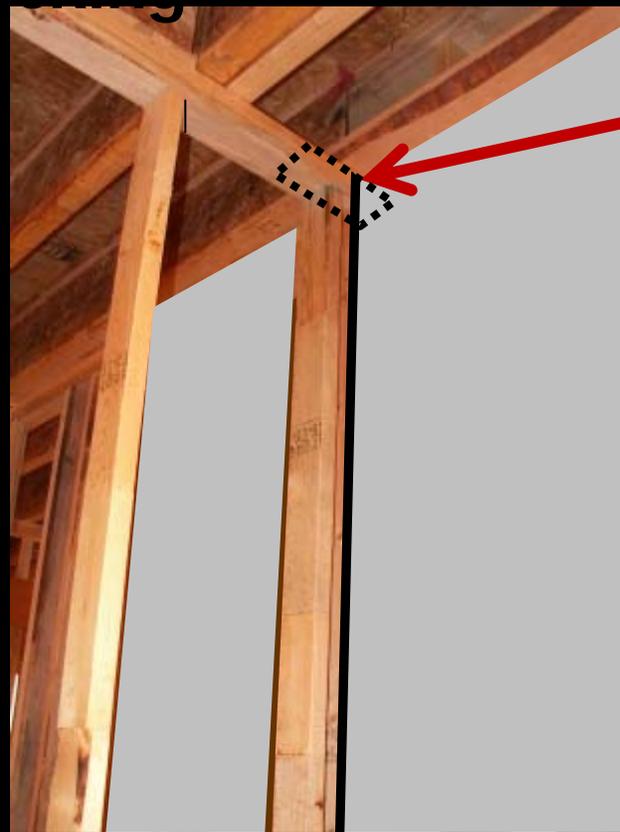


Advanced Framing:  
Ladder T – Allows  
insulation in  
exterior wall cavity  
at wall intersections



THERMAL BRIDGING

# ADVANCED FRAMING: WALL INTERSECTIONS



1" Gap

# THERMAL BRIDGING ADVANCED FRAMING



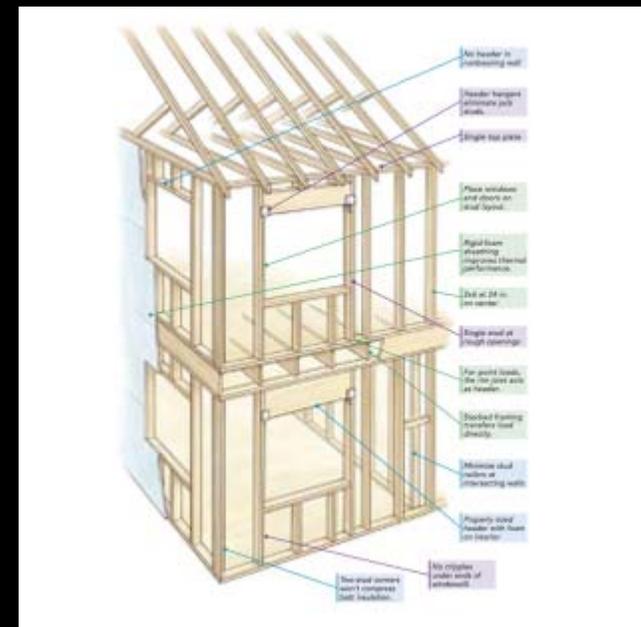
Courtesy of Building Science Corp.

# THERMAL BRIDGING: ADVANCED FRAMING



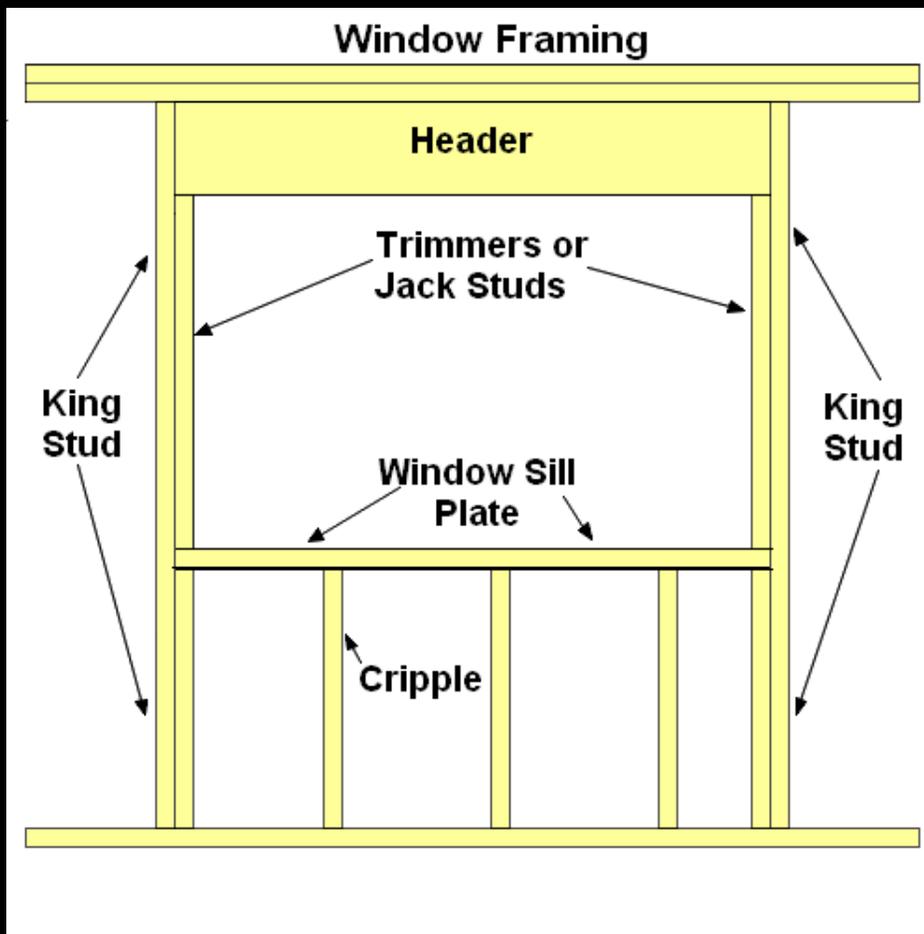
- 16" o.c. for 2 x 4 framing; or
- 24" o.c. for 2 x 6 framing; with
- No more than 5% of studs may lack an apparent/documentated structural purpose\*

\*equivalent to one stud every 30 feet for 16" o.c.



## THERMAL BRIDGING

# ADVANCED FRAMING: WINDOWS & DOORS



One pair of king studs

One pair jack studs

Additional only as needed for structural support

Cripple studs as needed to maintain on-center spacing of studs

THERMAL BRIDGING

# ADVANCED FRAMING: INSULATED HEADERS



# THERMAL BRIDGING RIGID INSULATION SHEATHING



Courtesy of Building Science Corp.



# THERMAL BRIDGING STRUCTURAL INSULATION SHEATHING



# THERMAL BRIDGING ADVANCED WALL SYSTEMS



**SIPs**

**ICF**

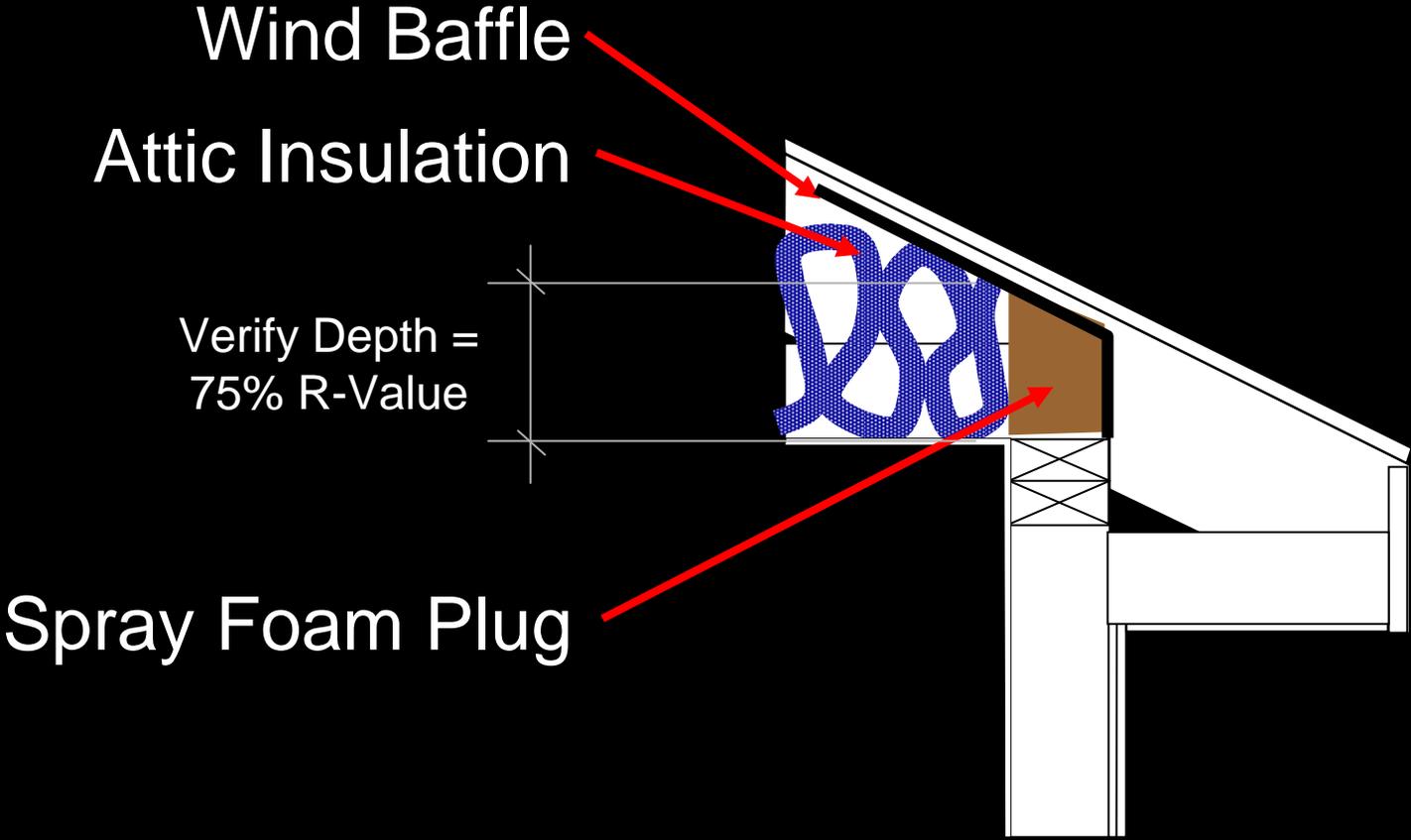


**Double  
Wall**

# THERMAL BRIDGING RAISED HEEL TRUSSES



THERMAL BRIDGING  
RAISED HEEL TRUSS ALTERNATIVE

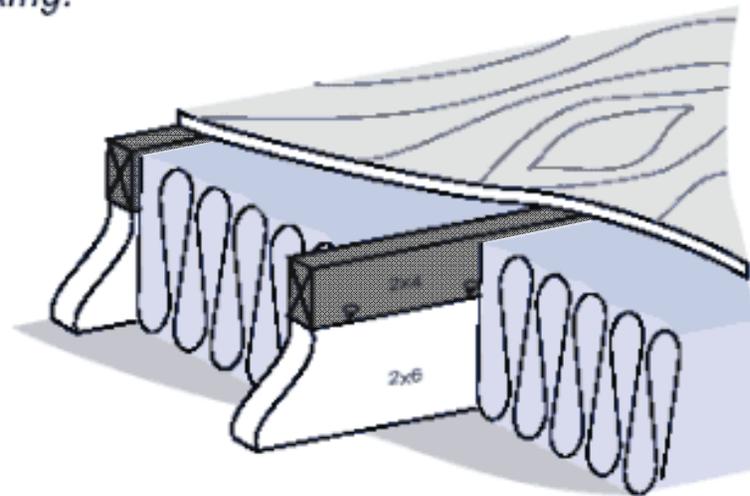


# THERMAL BRIDGING RAISED PLATFORM FRAMING



## INCREASE ATTIC INSULATION LEVELS UNDER DECKING

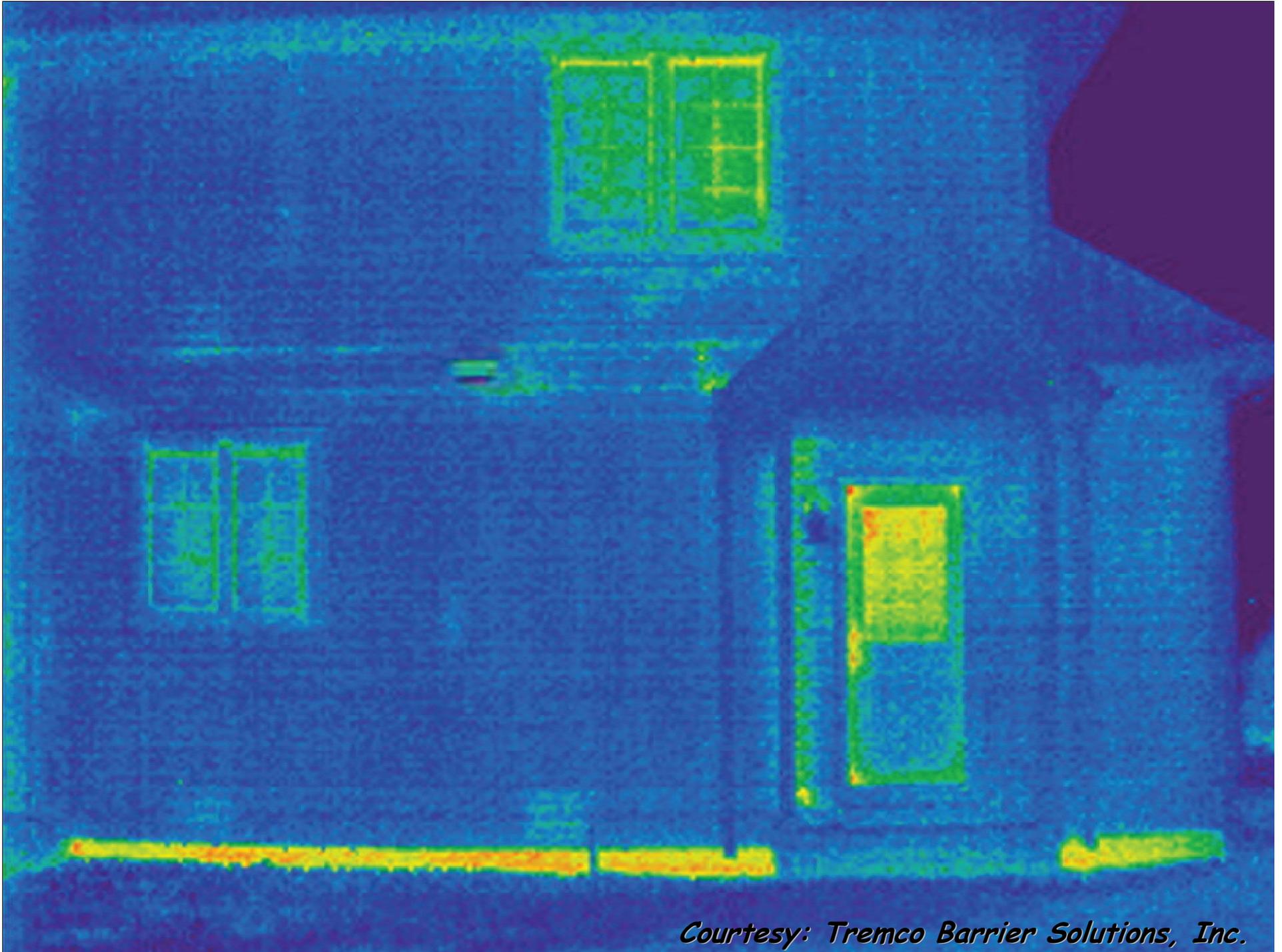
*For many products, an insulation depth of 10 to 14 inches is needed to achieve an R-30 to R-38 insulation value. Thus, a 2x4 or 2x6 extension needs to be added to a 2x6 joist to provide sufficient depth before installing decking.*





# RAISED PLATFORM FRAMING





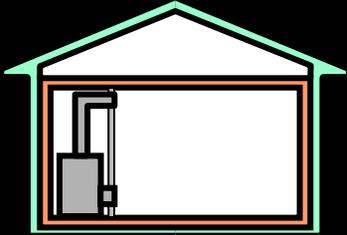
*Courtesy: Tremco Barrier Solutions, Inc.*

# THERMAL ENCLOSURE SYSTEM VALUE PROPOSITION



- Visibly better **quality**
- Superior **comfort and health**
- Future **resale value**





# MANDATORY REQUIREMENTS CHECKLISTS



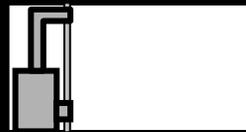
## Thermal Enclosure System:

- Air Leakage
- Insulation R-Value
- Insulation Installation
- Air Barriers
- Thermal Bridging
- High-Perf. Windows



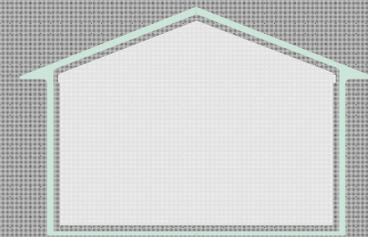
## HVAC Quality Installation System:

- Efficient Equipment
- Right-Sizing
- Air Distribution
- Refrigerant Charge
- Duct Installation
- Pressure Balancing
- Ventilation
- Filtration

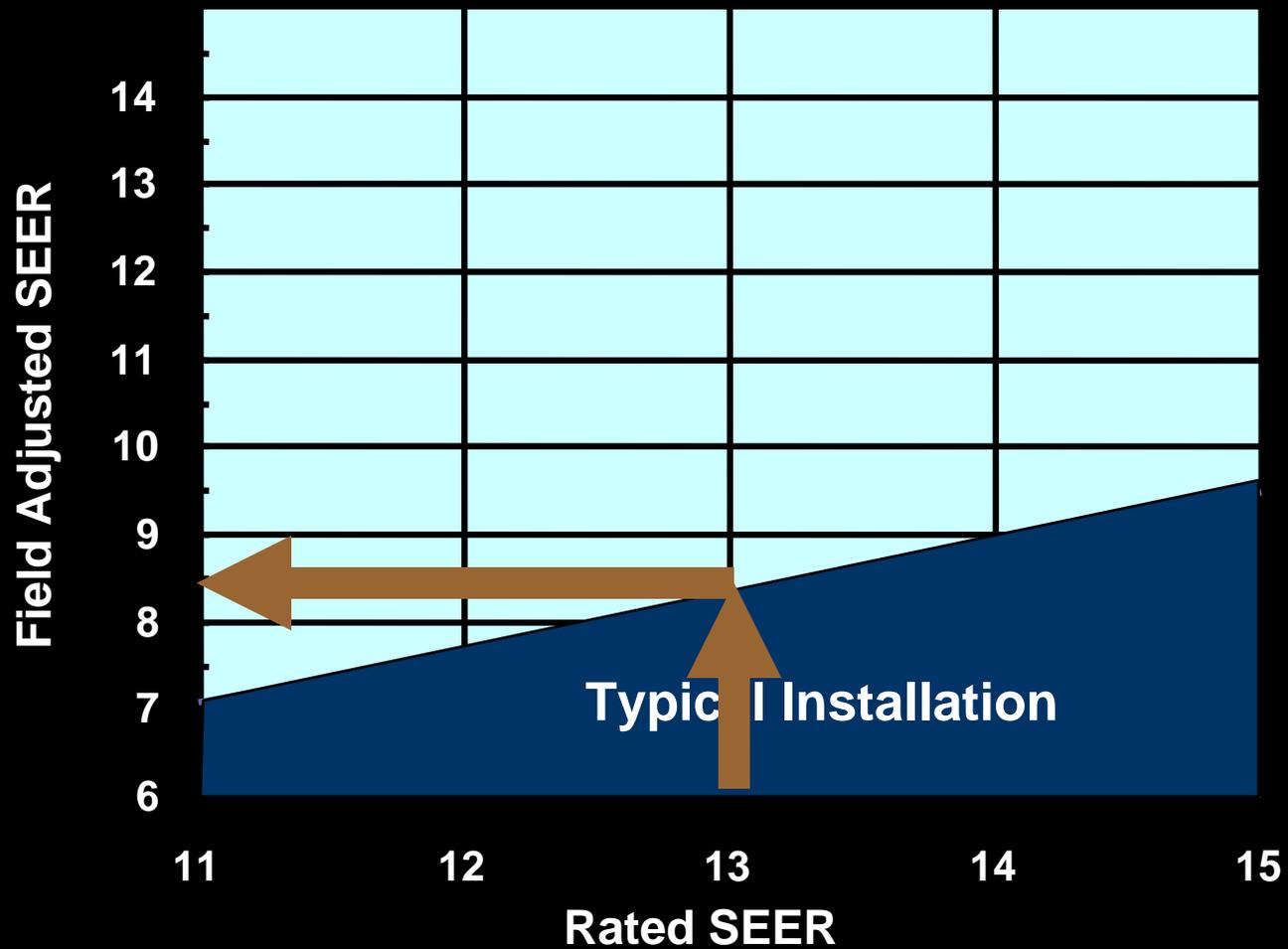


## Water Management System:

- Roof Membranes
- Flashing
- WRB's
- Fabric Filters
- Capillary Breaks
- Drainage Layer

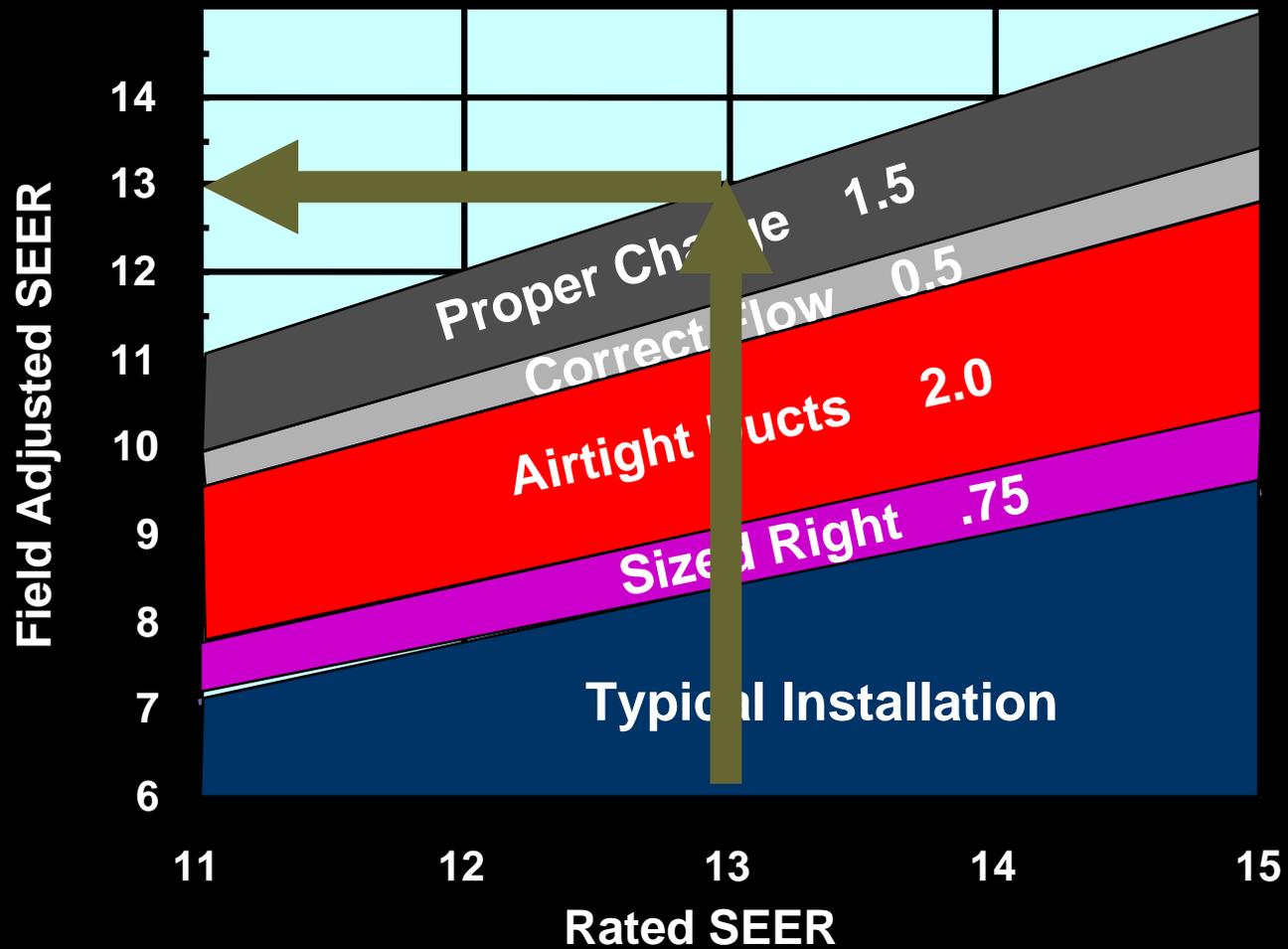


# HVAC SYSTEM QUALITY INSTALLATION



Courtesy of Advanced Energy Corp.

# HVAC SYSTEM QUALITY INSTALLATION



Courtesy of Advanced Energy Corp.

# HVAC QUALITY INSTALLATION



**HVAC Contractor**

**Right-Sizing**

Equipment (ACCA Manual J/S)  
Ducts (ACCA Manual D)

**Equipment Selection**

Matched Components  
Sensible Heat Ratio

**Air Distribution**

Flow Across Coil  
Room-by-Room Air Flow  
Static Pressure

**Refrigerant Charge**

Testing  
TXV Valve

# HVAC QUALITY INSTALLATION



**HERS Rater**

## **Duct Installation**

Duct Installation  
R-8 Ducts in Attic  
Leakage to Outdoors and Total  
Pressure Balancing

## **Sizing/Selection**

Load Design Inputs  
Installed Equipment Size  
Matching Equipment  
Measure Flow Across Coil  
Refrigerant Calculations  
Control Operations  
Verify Supply/Return Grill Counts



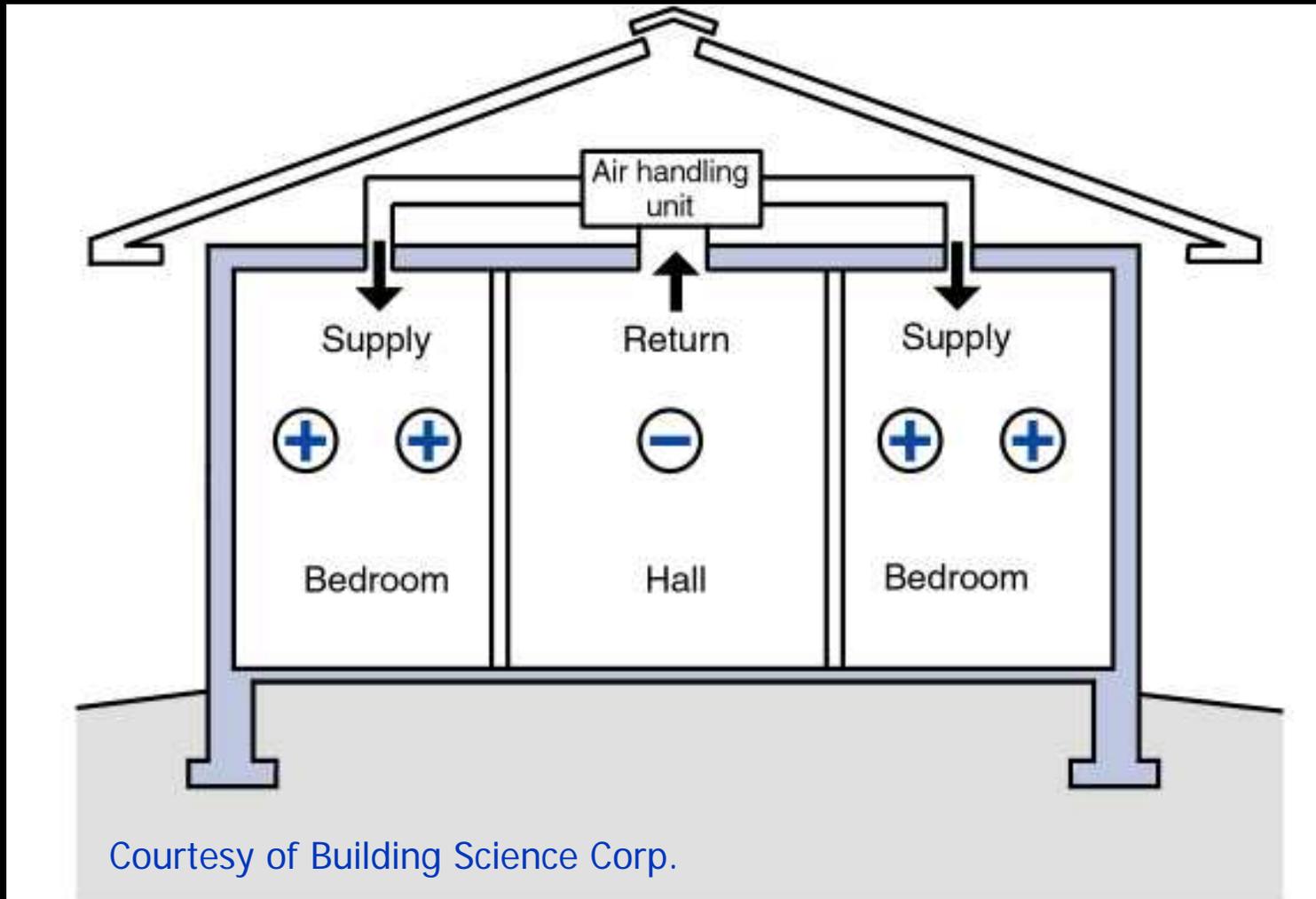
**Exit grille is over here !**





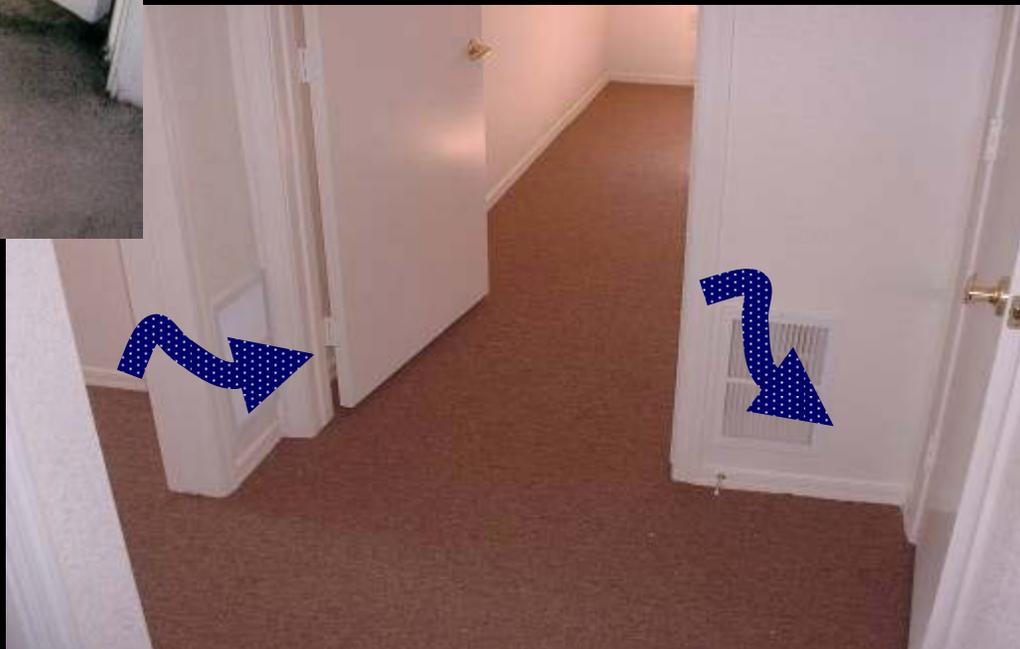


# PRESSURE BALANCING: PROBLEM

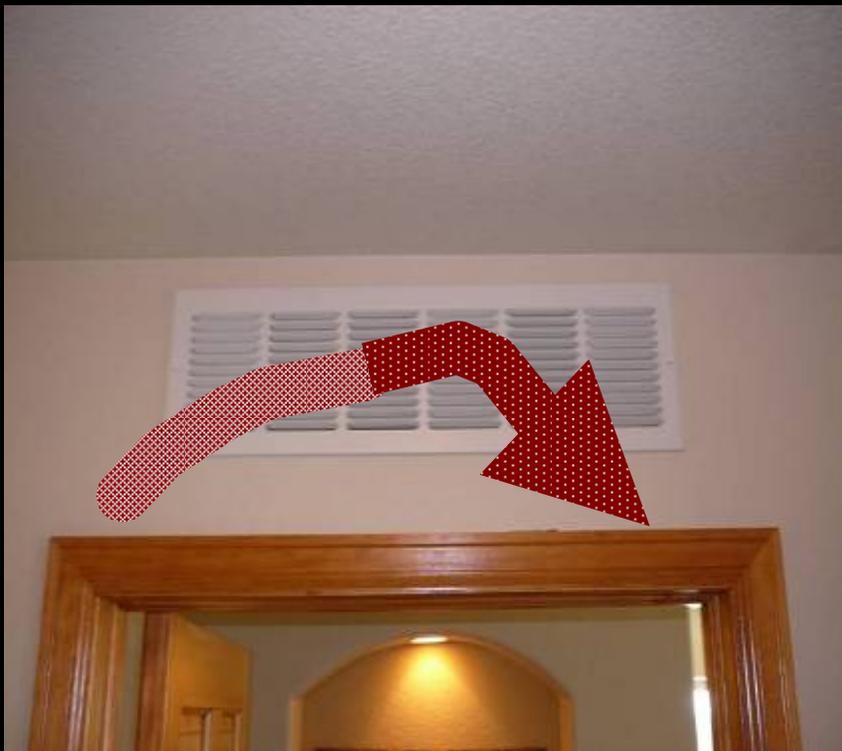


Courtesy of Building Science Corp.

# PRESSURE BALANCING: SOLUTION: TRANSFER GRILLS



# PRESSURE BALANCING: SOLUTION: TRANSFER GRILLS



# PRESSURE BALANCING: SOLUTION: JUMP DUCT



# WHOLE-HOUSE VENTILATION



CONTINUOUS EXHAUST



FRESH AIR  
DAMPER



DUCTED FRESH AIR SUPPLY

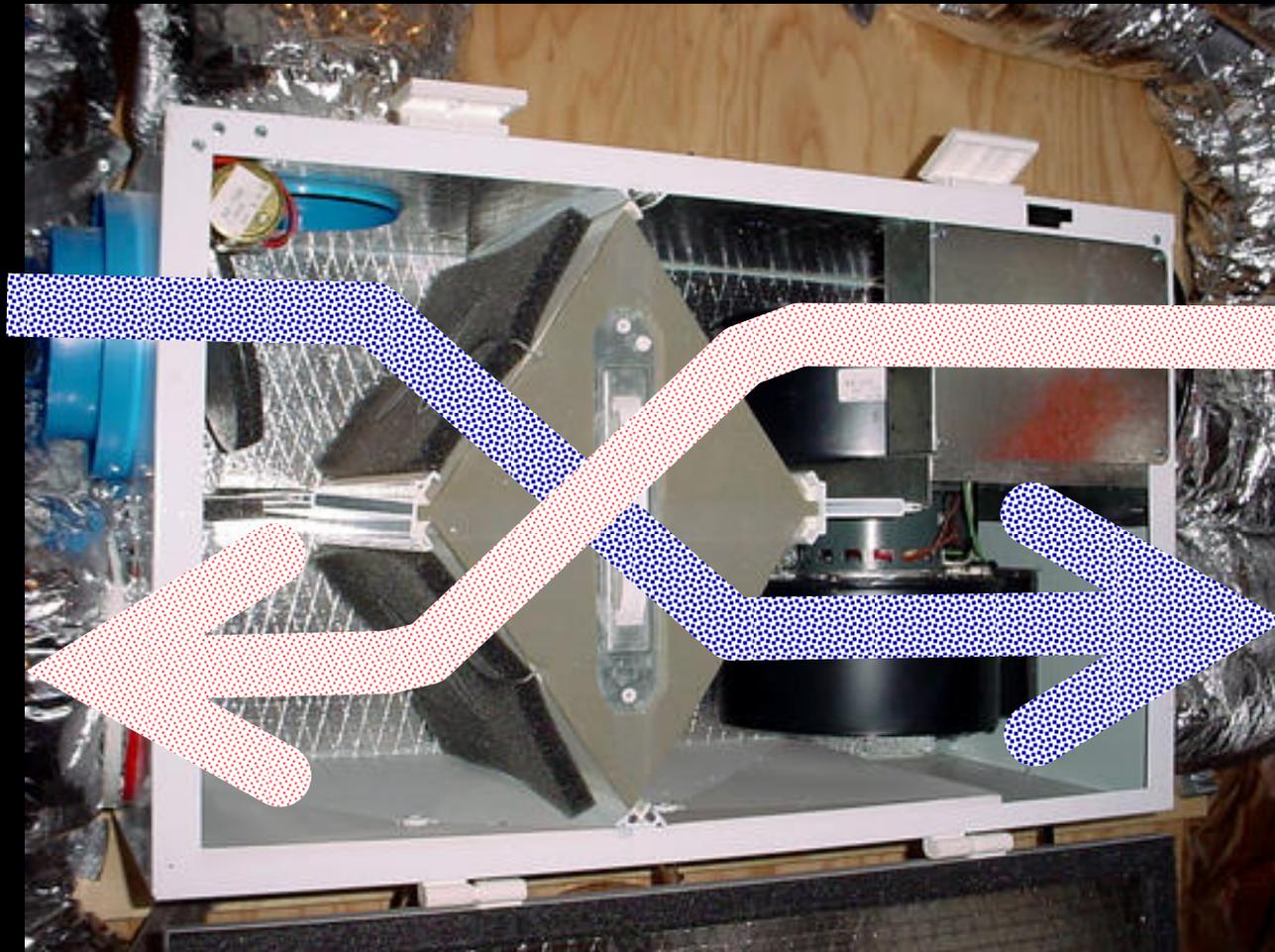
# WHOLE-HOUSE VENTILATION



THRU-WALL EXHAUST/SUPPLY

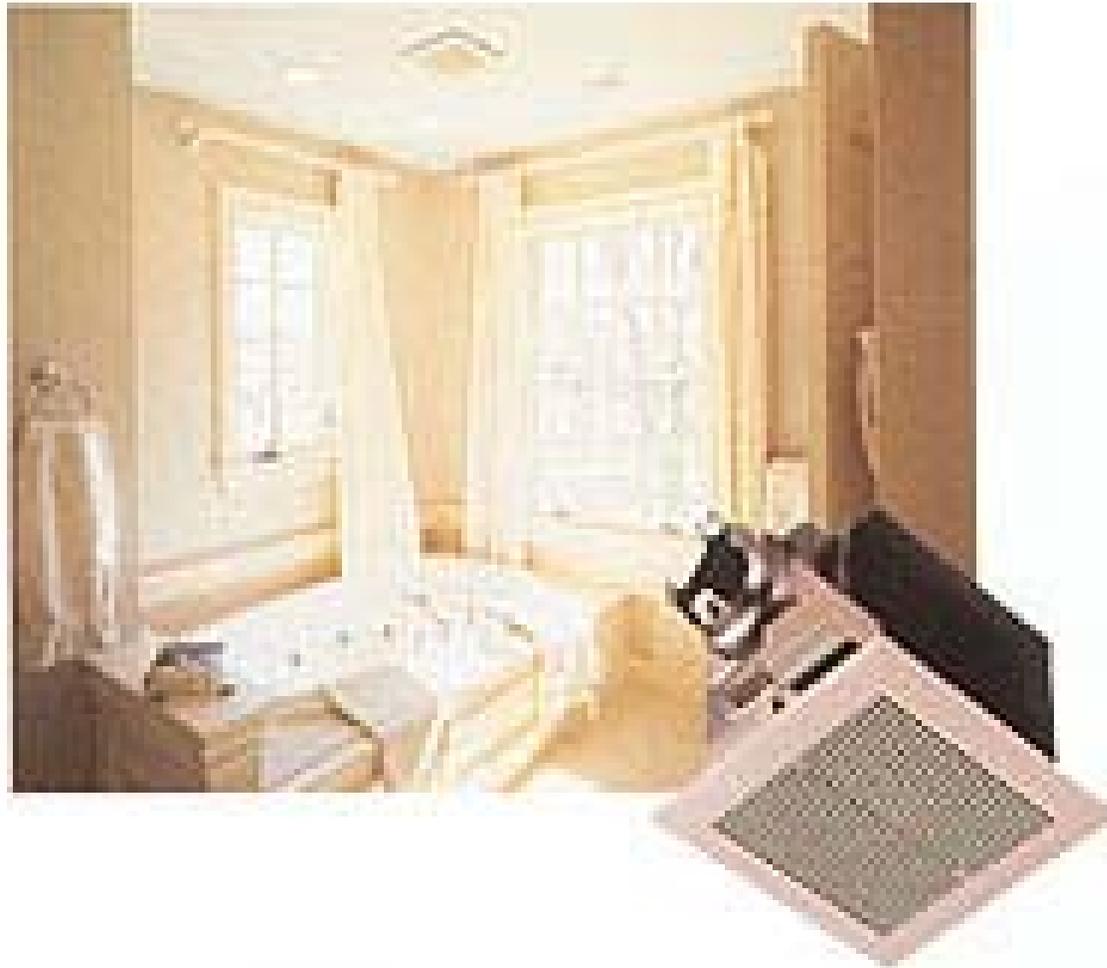


# WHOLE-HOUSE VENTILATION



ERV AND HRV

# SPOT VENTILATION

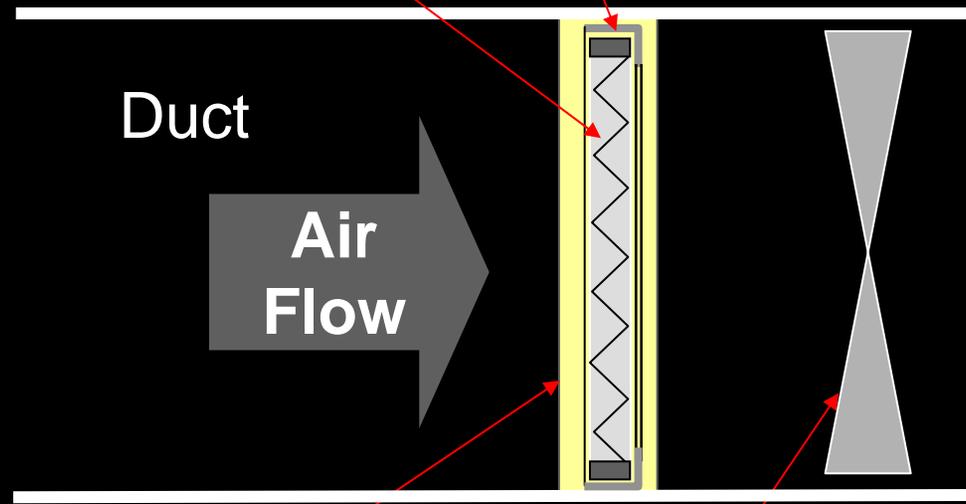




# FILTRATION

Angle frame for filter

$\geq$  MERV 6 Filter  
snug against frame  
with fan pressure



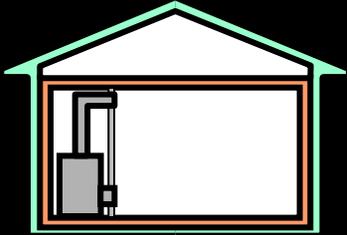
Tight fit cover slot

FAU Fan

# HVAC System Quality Installation Value Proposition



- **Get What You Pay For**
- **Engineered Comfort**
  - Thermal Control
  - Humidity Control
  - Noise Control
- **Assured Fresh/Filtered Air**



# MANDATORY REQUIREMENTS CHECKLISTS



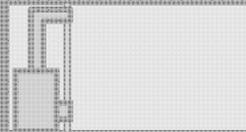
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- High-Perf. Windows



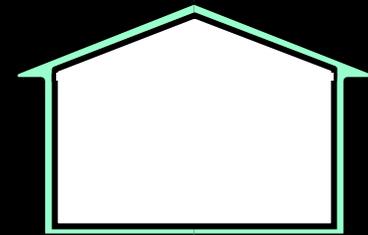
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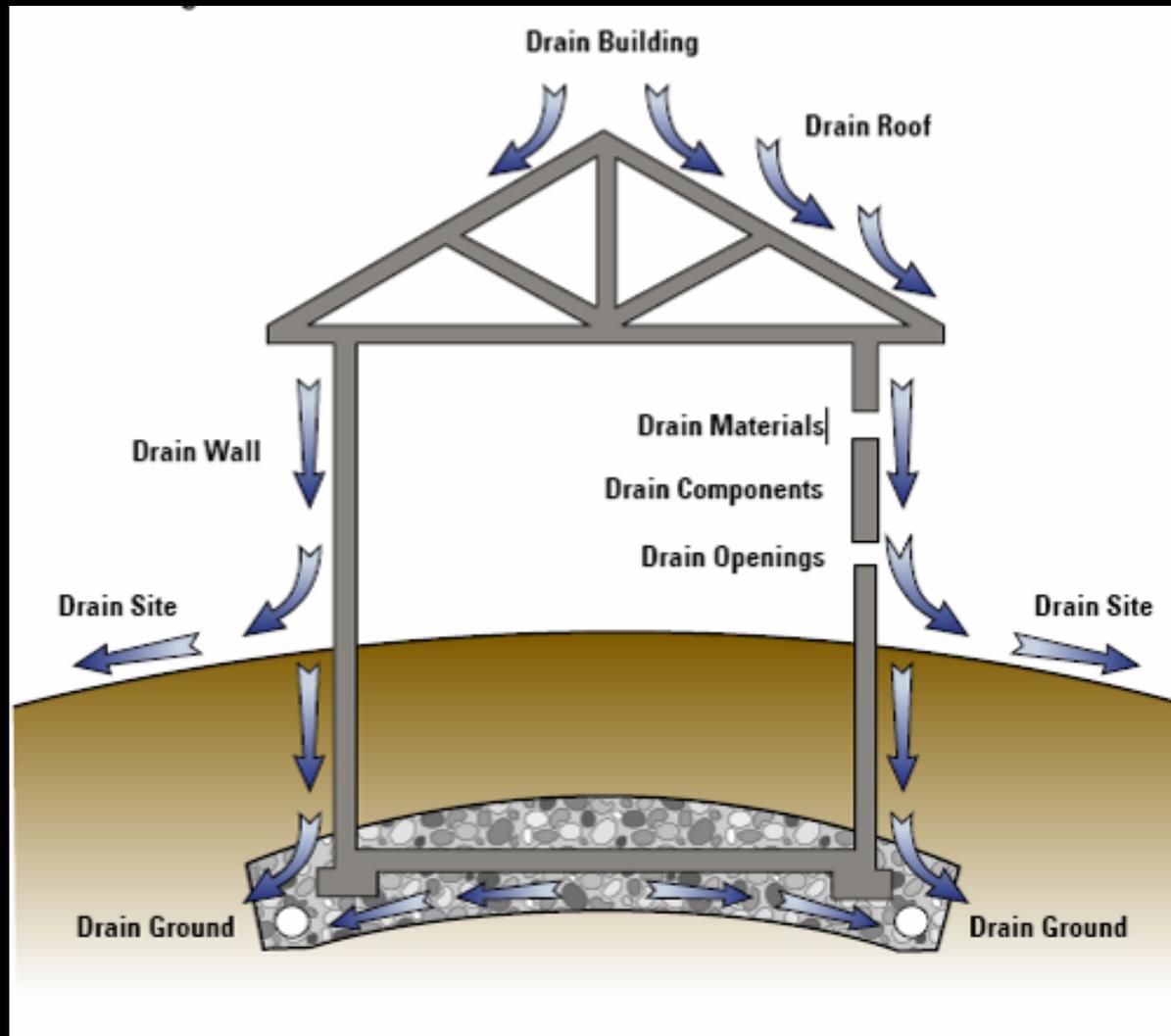


## Water Management System:

- Roof Membranes
- Flashing
- WRB's
- Fabric Filters
- Capillary Breaks
- Drainage Layer



# WATER MANAGEMENT SYSTEM CONCEPT



## WATER MANAGED ROOFS

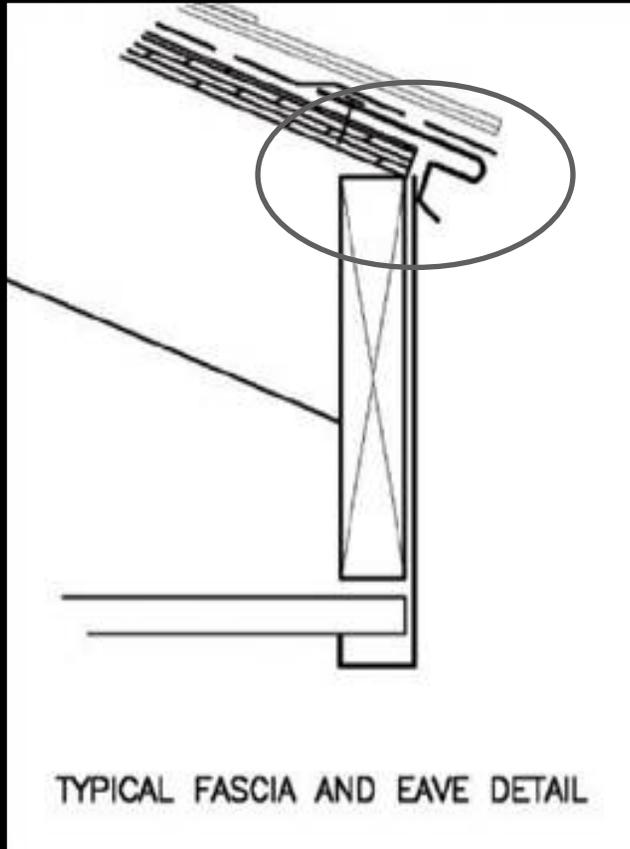
For consideration:

**one inch rain** on

**2,000 sq. ft.** roof deposits

**1,250 gallons** of water

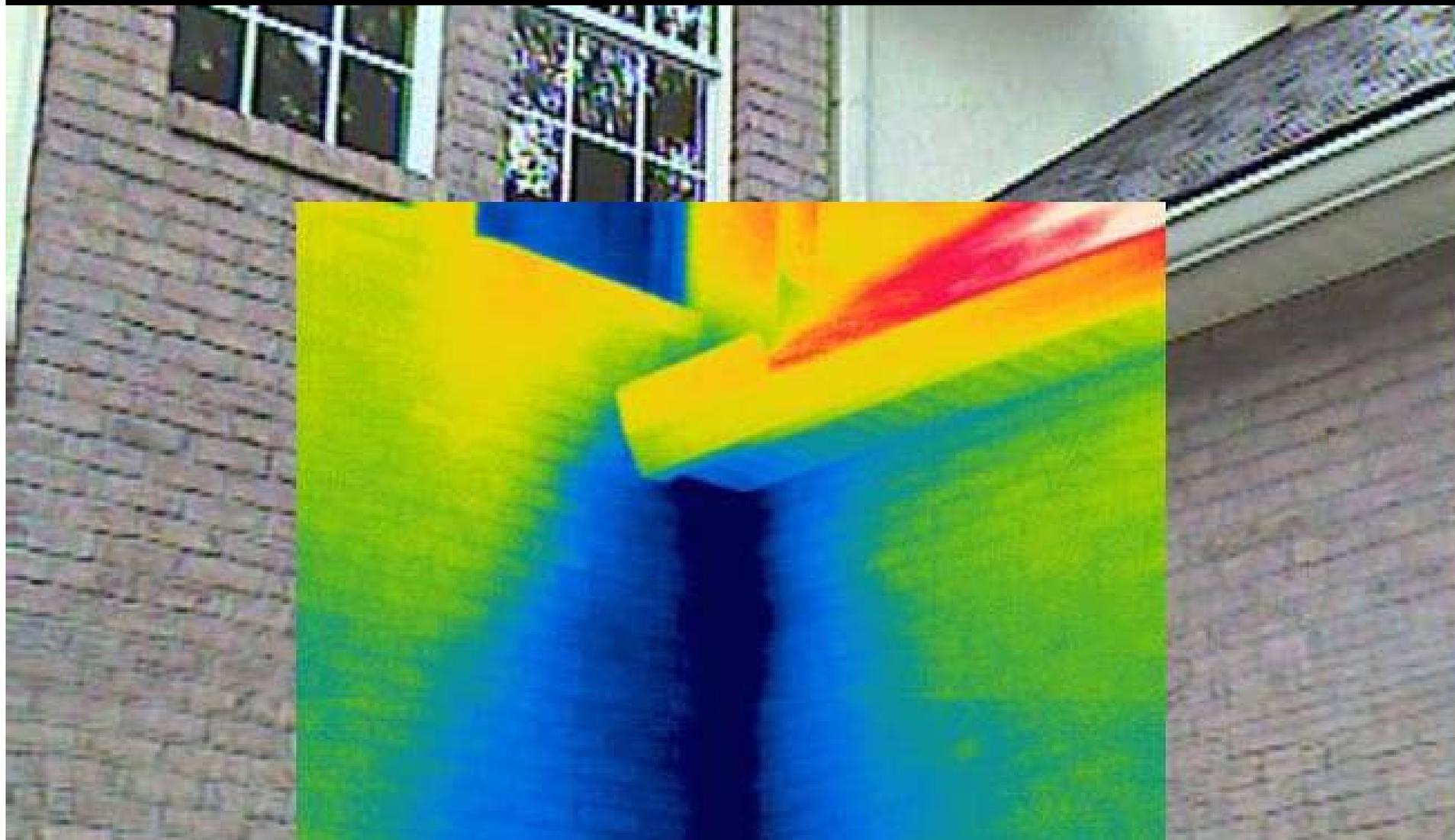
# WATER MANAGED ROOFS

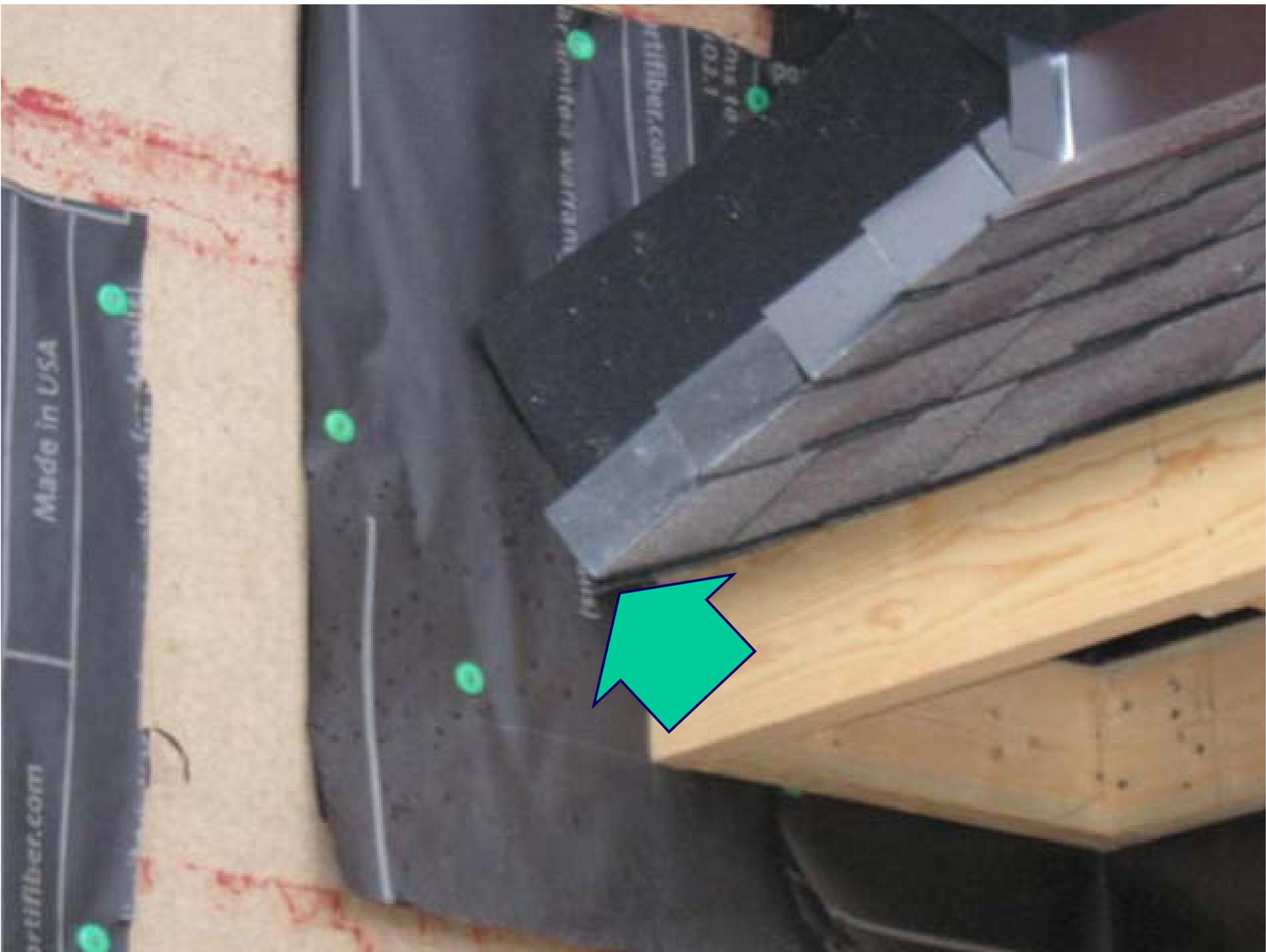


## HEAVY BITUMINOUS MEMBRANE AT EAVES AND VALLEYS



# WATER MANAGED ROOFS



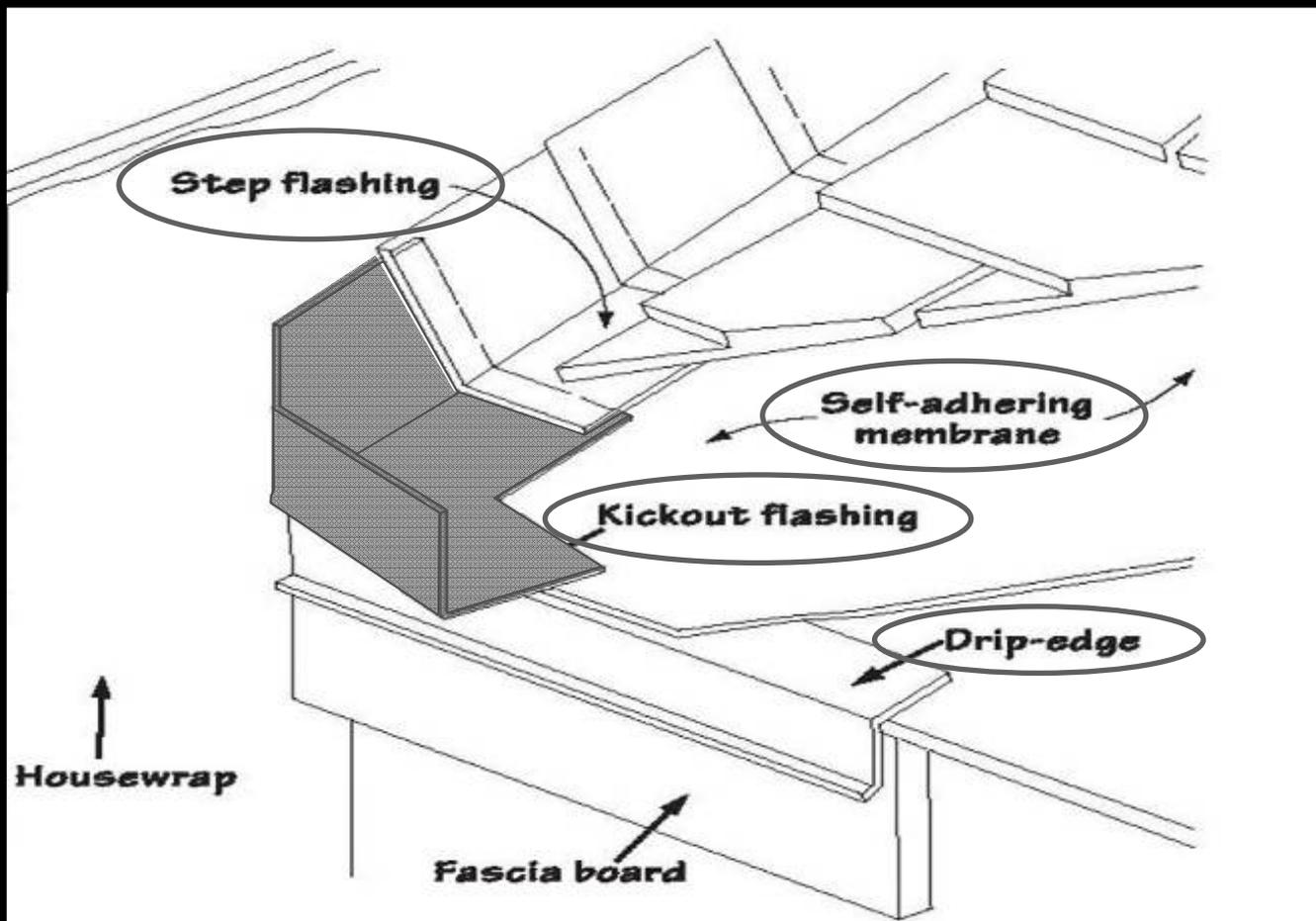




# WATER MANAGED ROOFS



## ROOF FLASHING DETAILS



# WATER MANAGED ROOFS



# WATER MANAGED ROOFS



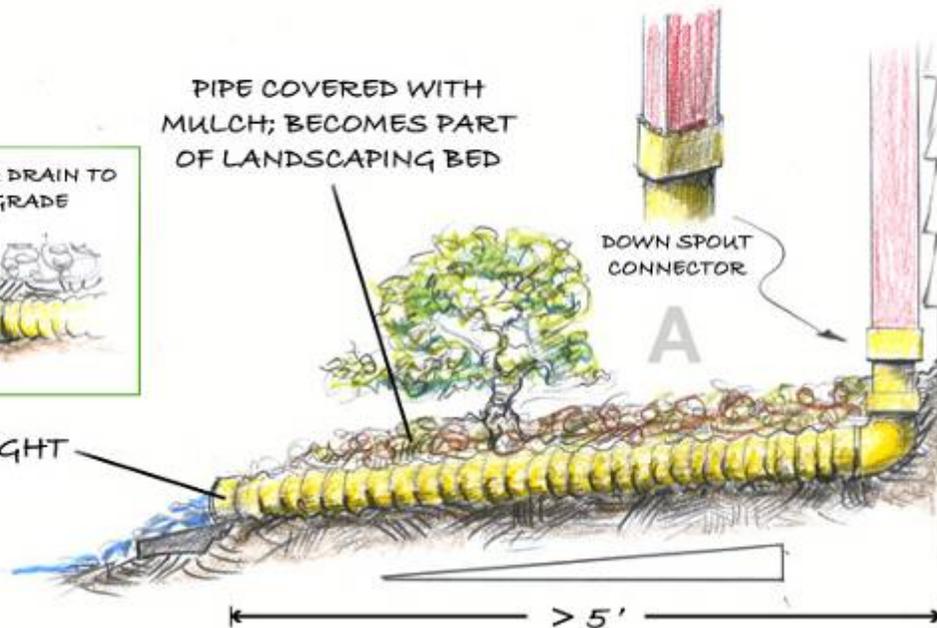
DRAIN TO DAYLIGHT

PIPE COVERED WITH MULCH; BECOMES PART OF LANDSCAPING BED

DOWN SPOUT CONNECTOR

**A**

> 5'



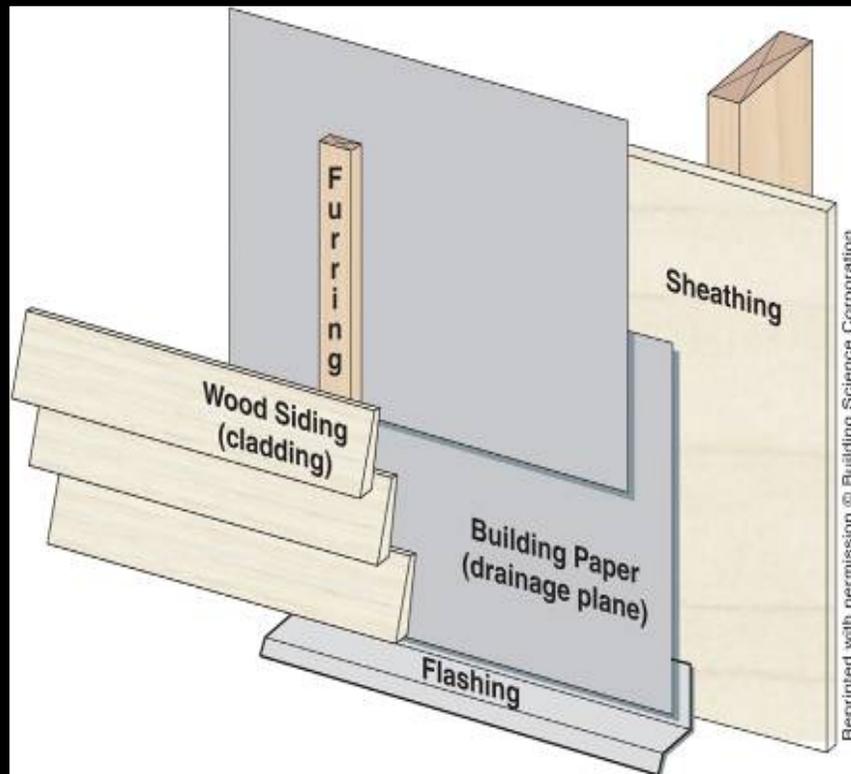
# WATER MANAGED WALL PROBLEM



# WATER MANAGED WALLS



# WATER MANAGED WALLS

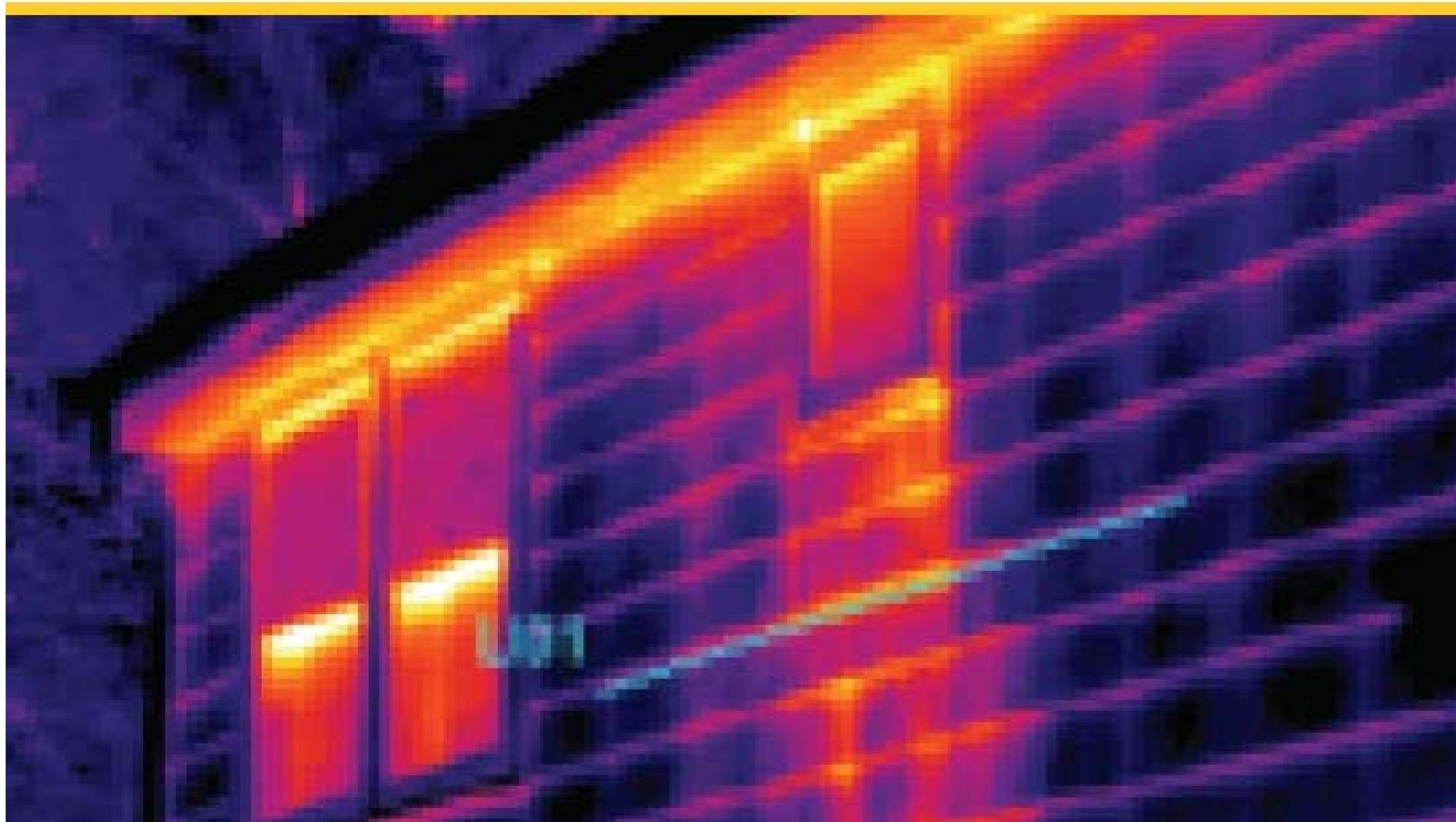


## DRAINAGE PLANE DESIGN

# WINDOW FLASHING PROBLEM



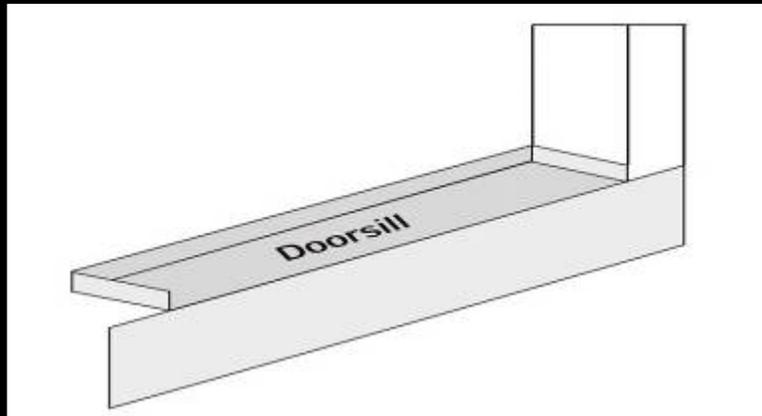
# WINDOW FLASHING PROBLEM REVEALED



# WATER MANAGED WALLS



## WINDOW/DOOR PAN FLASHING



## BEST PRACTICE



### WINDOW FLASHING

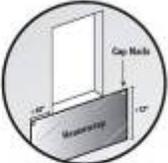
*Building Tips*

Example of window flashing details for home with basement and plywood or OSB wall sheathing.



---

**STEP 1 • FOLLOWUP TO NUT DRILL INSTALL**



- Apply at least a 12" flap, or space, of building paper or housewrap just below the windowsill.
- If the windowsill is close to the sill plate, the space can extend all the way to the sill plate.
- The space should extend at least 18" past the sides of the window opening, or to the first stud in open wall construction.
- Attach only the space's top edge with cap nails.

**STEP 1 • FOLLOWUP TO INSULATION**



- Cut the housewrap covering the rough opening in the shape of a modified "T".
- Fold the side and bottom flaps into the window opening and attach.
- Above the window opening, cut a lead flap and flip up to expose sheathing, and locate tape in place out of the way.

---

**STEP 2 • SILL FLASHING**



- Install self-adhesive flashing to the sill, ensuring that flashing extends up joints at least 6".
- On the remaining product contact with two non-adhesive strips over the adhesive. Reverse the first strip to expose half the adhesive and apply this strip to the sill. Begin pressing in the middle of the sill and work towards the sides. Reverse the second strip to expose the adhesive that will be used to apply the flashing below the window to the outside wall.
- Tape down the bottom corners of the flashing.

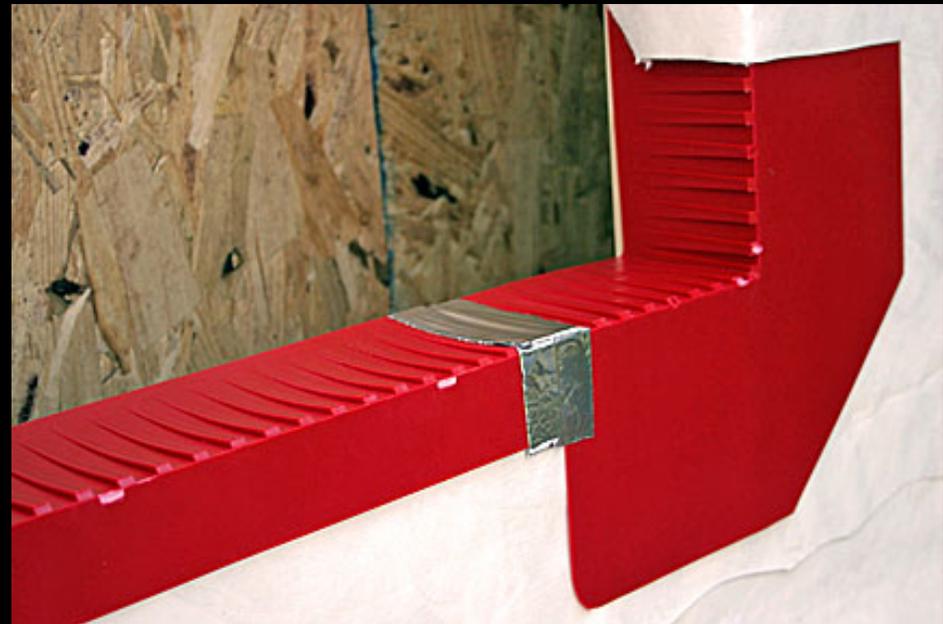
**STEP 3 • JOINT CALLING**



- Call the outside edges of the head and side joints.
- Do not call across the sill.
- Install the window using expansion-resistant nails and following manufacturer's specifications.

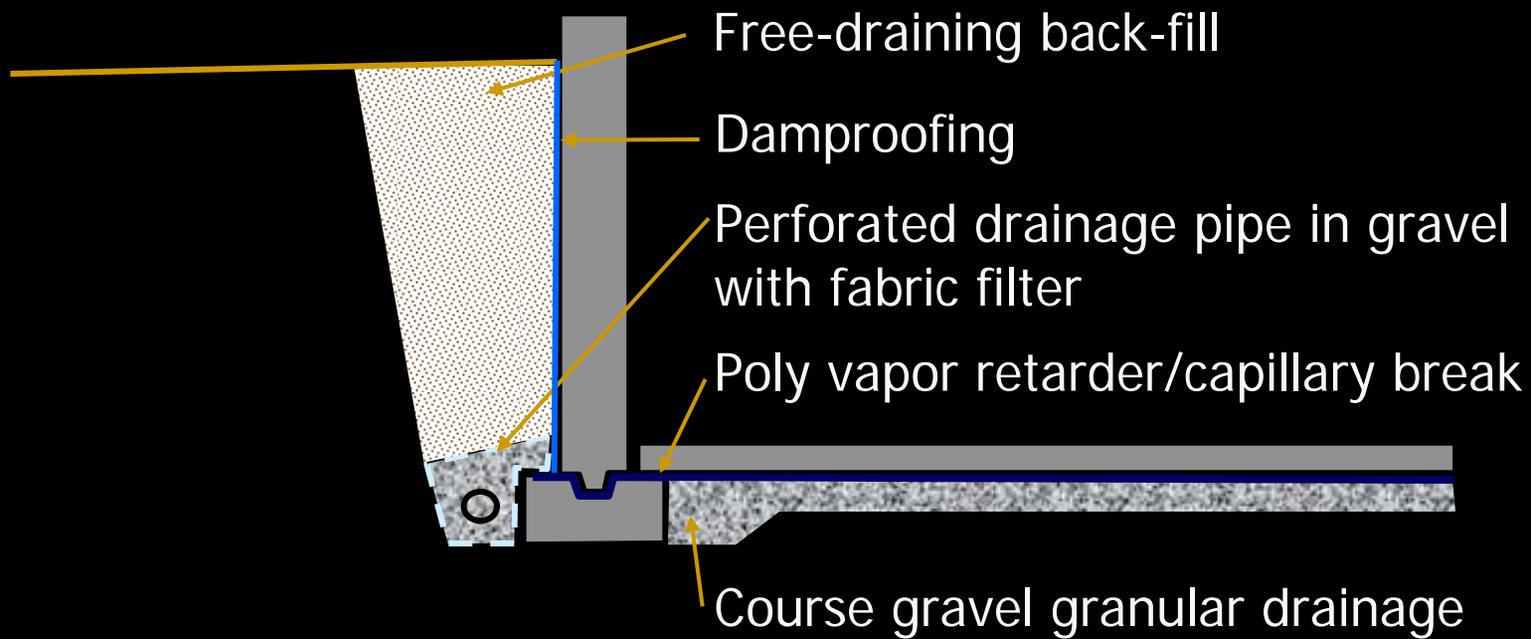
Building America Best Practices Series Volume 2 - Builders and Design Handbook for Improving  
 The Home Efficiency, Comfort, and Durability in the Hot-Dry and Mixed-Dry Climate Version 3.0/2005 • TR2.4

# WATER MANAGED WALLS

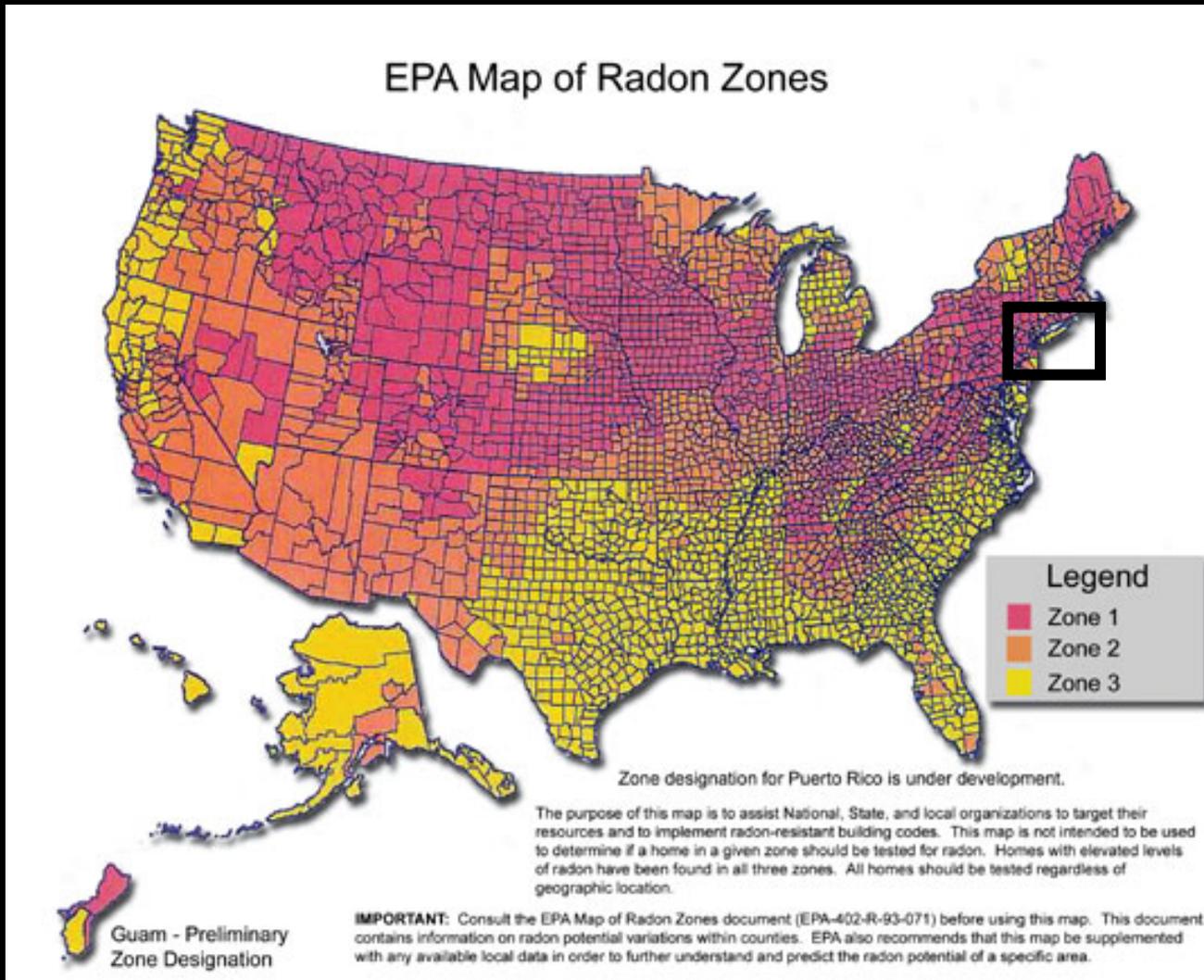


WINDOW/DOOR PAN FLASHING

# WATER MANAGED FOUNDATION



# CAPILLARY BREAKS = RADON BREAKS



# CAPILLARY BREAKS



## UNVENTED CRAWLSPACE

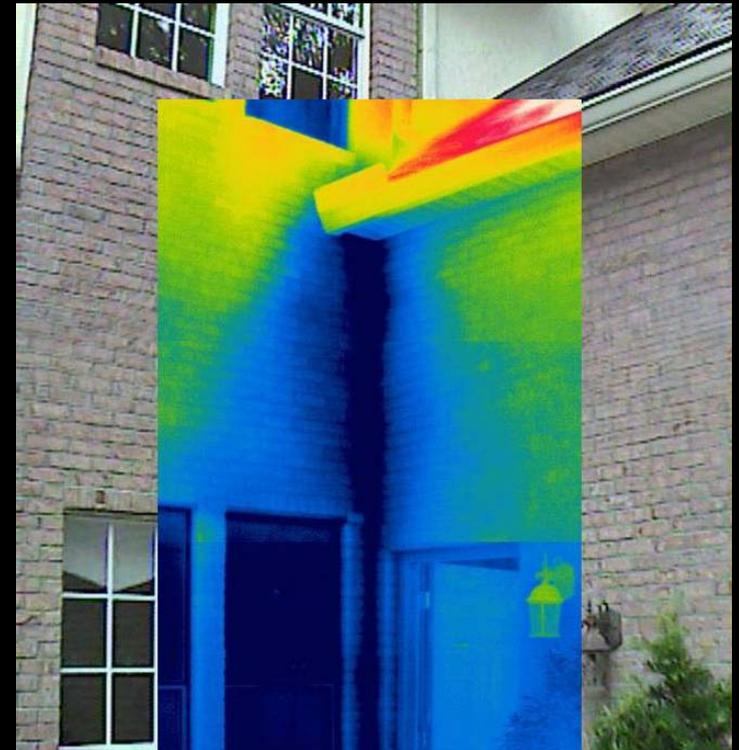


## POLY UNDER SLAB VAPOR AND RADON BARRIER

# Water Management System Value Proposition

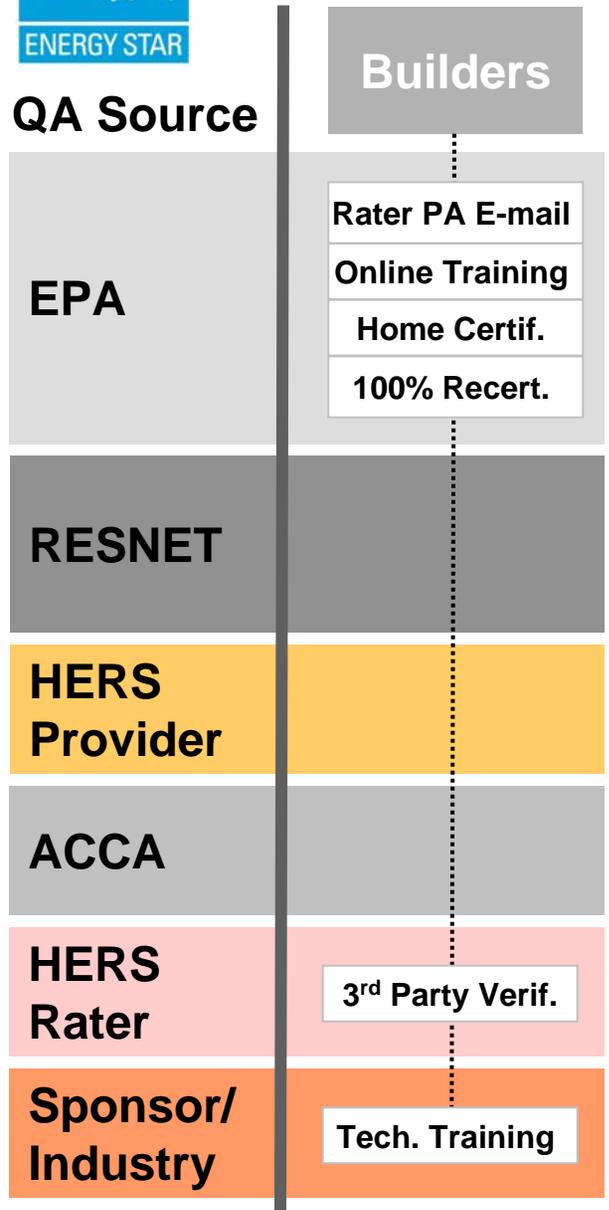


**Better protection** for largest investment  
**Lower maintenance**  
**Healthier home**





# ENERGY STAR Qualified Homes QA Flow Chart





## An ENERGY STAR<sup>®</sup> Qualified Home

This home built at

### 235 S Washington Street, Denver, CO

by Sean Smith & Company, LLC

has been verified by Populus, llc, an independent professional or organization,  
to meet or exceed strict energy efficiency guidelines  
set by the U.S. Environmental Protection Agency.

HERS Index: 37

04/24/09

A handwritten signature in black ink, appearing to read "David Lee".

David Lee  
Chief  
ENERGY STAR Residential Branch

A handwritten signature in black ink, appearing to read "Sam Rashkin".

Sam Rashkin  
National Director  
ENERGY STAR for Homes

[www.energystar.gov](http://www.energystar.gov)

# ENERGY STAR Qualified Home Certificate Report



## HOME INFORMATION

Builder Name:  
Permit Date/Number:  
Home Address:

## RATING INFORMATION

Rating Company:  
Rater Identification Number:  
Rating Date:

**ENERGY STAR FOR HOMES VERSION NUMBER:**

## YOUR ENERGY STAR QUALIFIED HOME FEATURES

Your home has been constructed to meet U.S. EPA's latest guidelines for energy efficiency including the following features:

### **A COMPLETE THERMAL ENCLOSURE SYSTEM:**

- Comprehensive air sealing  
(Blower Door Result)
- Code or Better Insulation Levels\*  
(R-values for attics, walls, floors)
- Properly installed insulation  
(RESNET Grade 1)
- High-performance windows\*  
(u-Value; SHGC)
- Complete Air Barrier
- Reduced Thermal Bridging  
(adv. framing, rigid insulation sheathing, adv. wall system)

### **A COMPLETE WATER MANAGEMENT SYSTEM:**

- Complete roof flashing details
- Heavy-duty membranes at roof valleys and eaves
- Pan flashing at all windows and doors
- Complete wall drainage plane
- Fabric filter at foundation drain
- Capillary break under foundation
- Site Drainage

### **A COMPLETE HEATING AND COOLING QUALITY INSTALLATION SYSTEM:**

- Efficient heating and cooling equipment  
(A/C SEER; Furnace AFUE, Boiler AFUE)
- Properly sized equipment and ducts
- Sealed and tested duct work  
(Duct Test Result)
- Verified proper refrigerant charge (when applicable)
- Whole-house and spot ventilation
- Programmable thermostat

### **ENERGY EFFICIENT LIGHTING AND APPLIANCES:**

- Efficient water heater  
(EF Rating)
- ENERGY STAR qualified lighting  
(list number of bulbs and/or fixtures)
- ENERGY STAR qualified appliances and fans  
(list specific products)

\* Where a feature varies across the home, the predominant performance level is shown.

3	FULLY-ALIGNED AIR-BARRIERS
1	WALLS
5	GARAGE RIM/BAND JOIST ADJOINING CONDITIONED SPACE

Checklist Reference

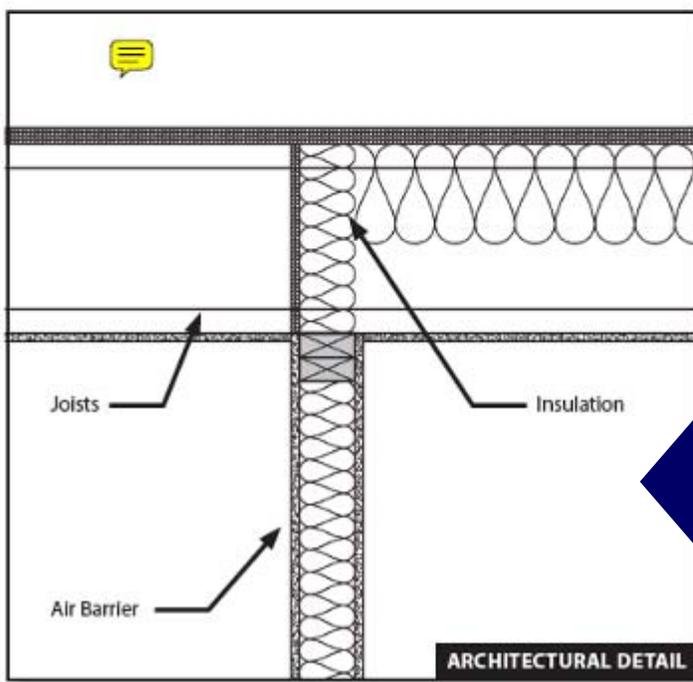


**SECTION 3: FULLY ALIGNED BARRIERS**

At each location noted below, a complete air barrier shall be provided that is fully aligned with the insulation as follows:

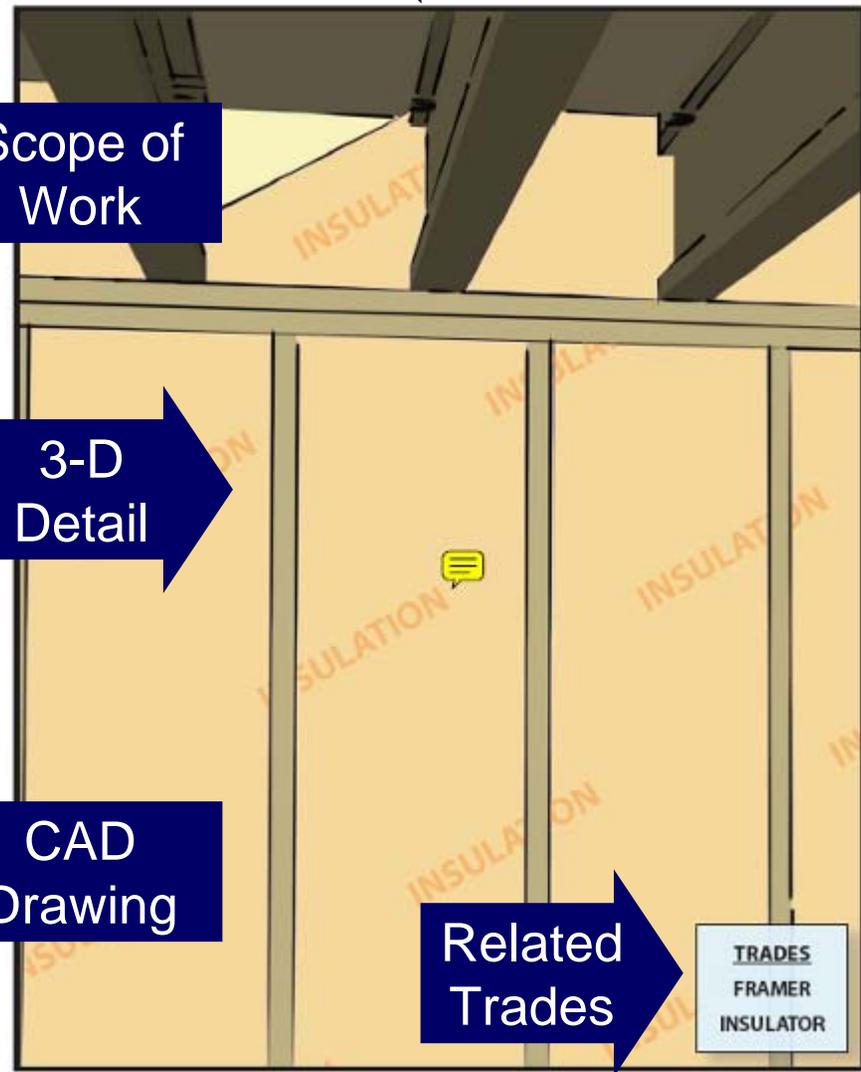
- At interior surface of ceilings in all climate zones
- At exterior surface of walls in all climate zones; and, for Climate Zones 4-8 only, also at interior surface of walls
- At interior surface of floors in all climate zones, including supports to ensure permanent contact and blocking at exposed edges

Scope of Work



3-D Detail

CAD Drawing



Related Trades

TRADES  
FRAMER  
INSULATOR

3	FULLY-ALIGNED AIR-BARRIERS
1	WALLS
5	GARAGE RIM/BAND JOIST ADJOINING CONDITIONED SPACE



1

**TIPS & TRICKS** — Forum rent, que popoenatant, quodis. Dintil vides hacsensus conduc temoveris hor audescens sulii publico nvehentiensu quasdac iorudam num achil utem, sentilnequa iam



3

**TIPS & TRICKS** — Forum rent, que popoenatant, quodis. Dintil vides hacsensus conduc temoveris hor audescens sulii publico nvehentiensu quasdac iorudam num achil utem, sentilnequa iam



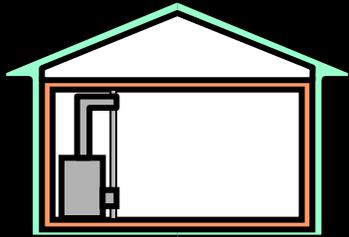
2

**TIPS & TRICKS** — Forum rent, que popoenatant, quodis. Dintil vides hacsensus conduc temoveris hor audescens sulii publico nvehentiensu quasdac iorudam num achil utem, sentilnequa iam



4

**TIPS & TRICKS** — Forum rent, que popoenatant, quodis. Dintil vides hacsensus conduc temoveris hor audescens sulii publico nvehentiensu quasdac iorudam num achil utem, sentilnequa iam



# COMPLETE SYSTEMS ARE BETTER



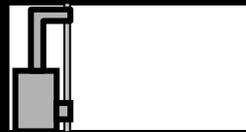
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- Insulation R-Value
- Insulation Installation
- Air Barriers
- Thermal Bridging
- High-Perf. Windows



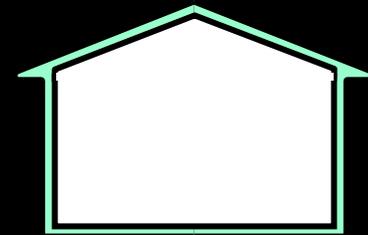
## HVAC Quality Installation System:

- Efficient Equipment
- Right-Sizing
- Air Distribution
- Refrigerant Charge
- Duct Installation
- Pressure Balancing
- Ventilation
- Filtration



## Water Management System:

- Roof Membranes
- Flashing
- WRB's
- Fabric Filters
- Capillary Breaks
- Drainage Layer



But...better is not good enough!



You have to **back up**

and **sell** compelling  
value propositions.

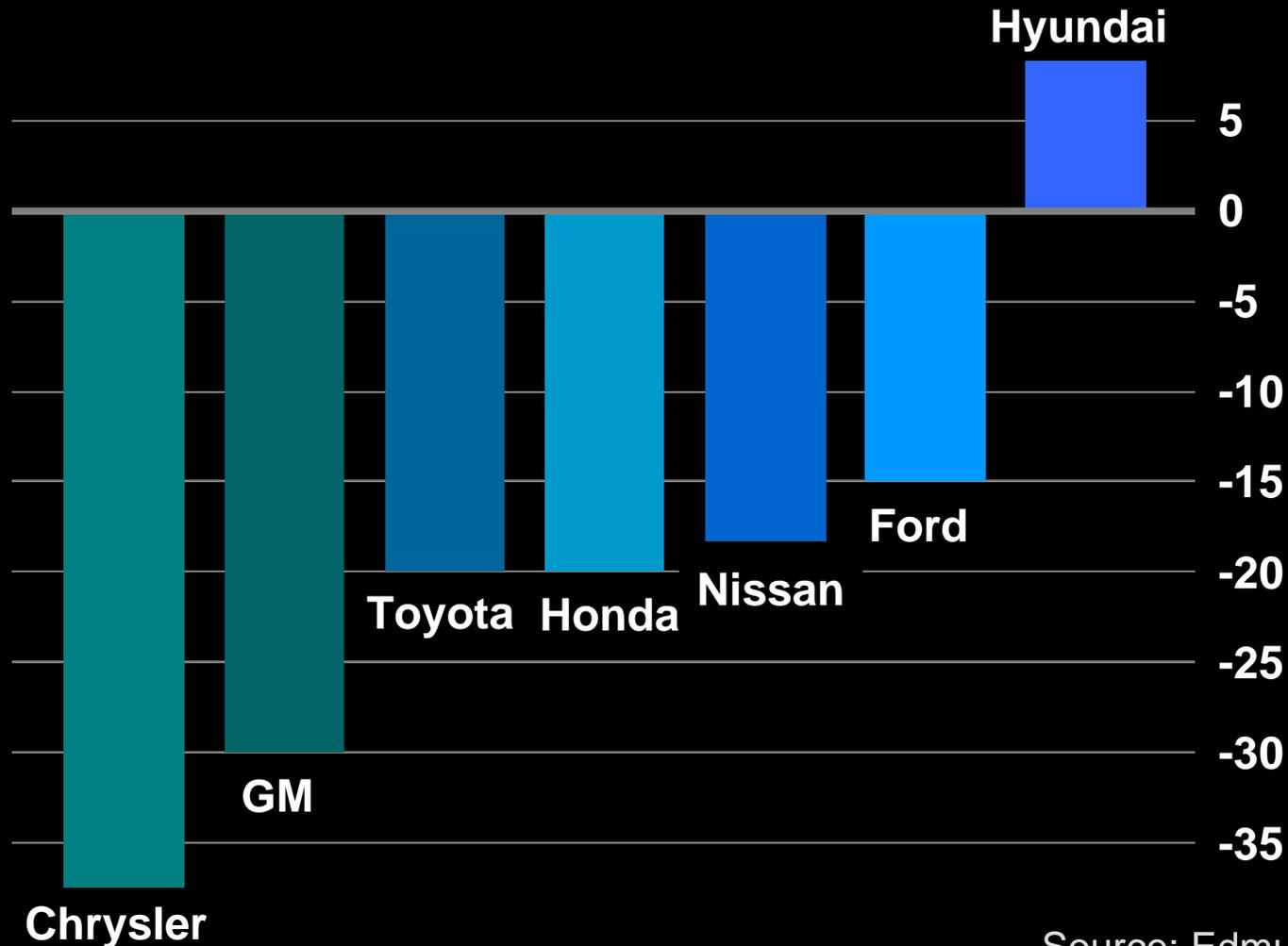
Better Test Scores



Better Reliability

# Back it Up Yields Results

## % Sales Changes 2008-2009



Source: Edmunds.com

# America's Best Warranty™



**Award-Winning Hyundai  
Quality Backed By  
America's Best Warranty™**

**10-Year/100,000-Mile  
Powertrain Protection**

**5-Year/60,000-Mile  
Bumper-to-Bumper Coverage**

**5-Year/Unlimited Miles  
24 hr. Roadside Assistance**

\*See dealer for LIMITED WARRANTY details.  
America's Best Warranty™: the Hyundai Advantage™

# Recognize This Builder?



## ...Toyota Homes

- \$200,000 - \$800,000 Modular Homes
- 45 Day Construction
- **Brand Advantage**  
[not withstanding recent efforts to destroy it]
- **60 Year Warranty**

## ...Toyota Homes

- \$200,000 - \$800,000 Modular Homes
- 45 Day Construction
- **Brand Advantage**  
[not withstanding recent efforts to destroy it]

- **60 Year Warranty**

# A CRAZY 'BACK IT UP' IDEA? ENERGY STAR V3 30-YR. WARRANTY



## Healthy Air Warranty

- Lead-Free\*
- Asbestos-Free\*
- Particulates Filtered to 3 Microns\*
- Mold-Free\*
- Combustion Gas-Free
- 150,000 CF per Day Fresh/Filtered Air\*
- VOC-Free\*
- Formaldehyde-Free\*
- Pest-Free\*
- Radon-Free\*

## Affordable Comfort Warranty

- \$60/Month Average Heating/Cooling Bill\*
- Even Room-by-Room Temperatures\*
- No Outdoor Drafts\*
- Outside Noise Reduction\*
- No Excessive Humidity\*

## Durability Warranty

- No Moisture Damage to Structure\*
- Dry Basements/Construction\*
- No Thermal Defects\*
- 90% UV Sunlight Blocked
- No Window Condensation\*

## Why \* in Warranty...

- Specified operating conditions
- Specified weather assumptions
- Specified number of occupants
- Specified limitations
- **Requirements for warranty service!!!**

**Why Back it UP...**

Because **You Can...**

And **They Can't!**

# Better is Not Good Enough... You Have to Sell ENERGY STAR



- Label Every Home
- Train Sales Agents
- **Hold Agents Accountable**
- **Create 'Value' Experiences**

**And Remember...**

- **Design & Location Trump**



# IF ENERGY STAR QUALIFIED HOMES IS THE SOLUTION, WHAT'S THE PROBLEM?

## **Solution**

## **Problem**

Energy Star V.1

Low Hanging Fruit Missing  
Lack of Verification Infrastructure

Energy Star V.2

Lack of Initial Building Science  
Lack of Energy Star Components

Energy Star V.3

Lack of Complete Building Science  
Lack of Quality Assurance

**Energy Star V.4**

**Lack of Net-Zero Ready Definition**

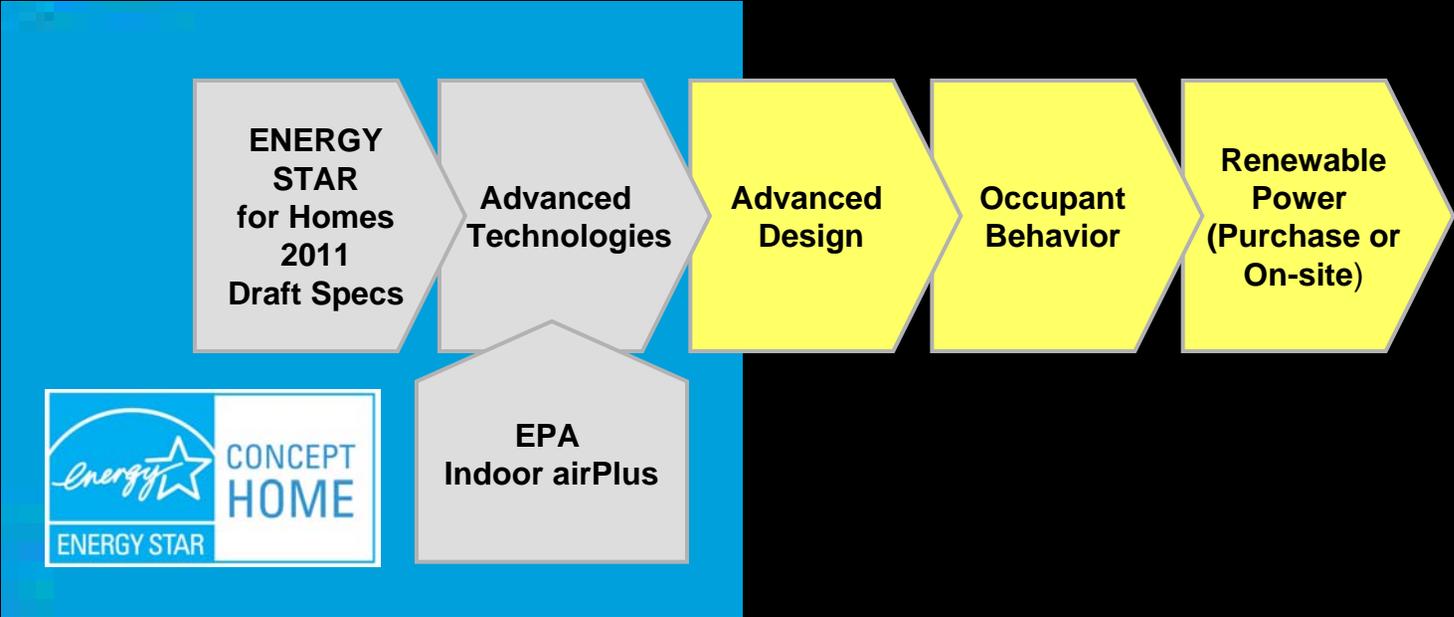
# Defining Net Zero-Ready



	Control Air Flow	Control Thermal Flow	Control Moisture Flow Bulk	Efficient Equipment	3 <sup>rd</sup> Party Verification
1996 V.4	Air Sealing Tight Ducts	Air Sealing Tight Ducts	Air Sealing Tight Ducts	Efficient HVAC Water Eff. Fixtures	Inspect Features Test Infiltration
1996 V.1		Insulation R-Value Low-E Windows		Eff. Water Distrib.	Test Duct Leakage
2006 V.2	Air Barriers	Air Barriers Insulation Alignment	Air Barriers Right-Sizing	Efficient WH System Efficient Lgtg./Appl.	Thermal Bypass Chk
2011 V.3	Pressure Balancing	Insulation Installation Min. Thermal Bridging	Ventilation Dehumid. in Hot/Humid	Water Man. Construction HVAC Quality Inst.	Thermal Enclos. Chk HVAC Sys. QI Chk Water Man. System Chk



# PATH TO NET-ZERO HOMES



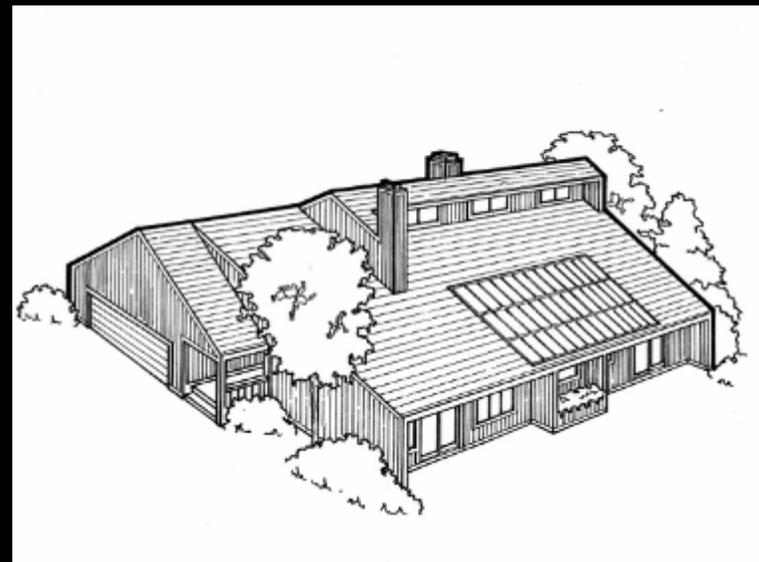
# Concept Home Value Proposition



## Net-Zero Ready

**~30% - 50% Less**

- Square Feet with 100% Function
- Cooling/Heating Loads
- Framing
- Ducts
- Plumbing
- HVAC Equipment
- Waste
- Construction Time



**~70% Less Call-Backs**

# 2011 SPEC Milestones



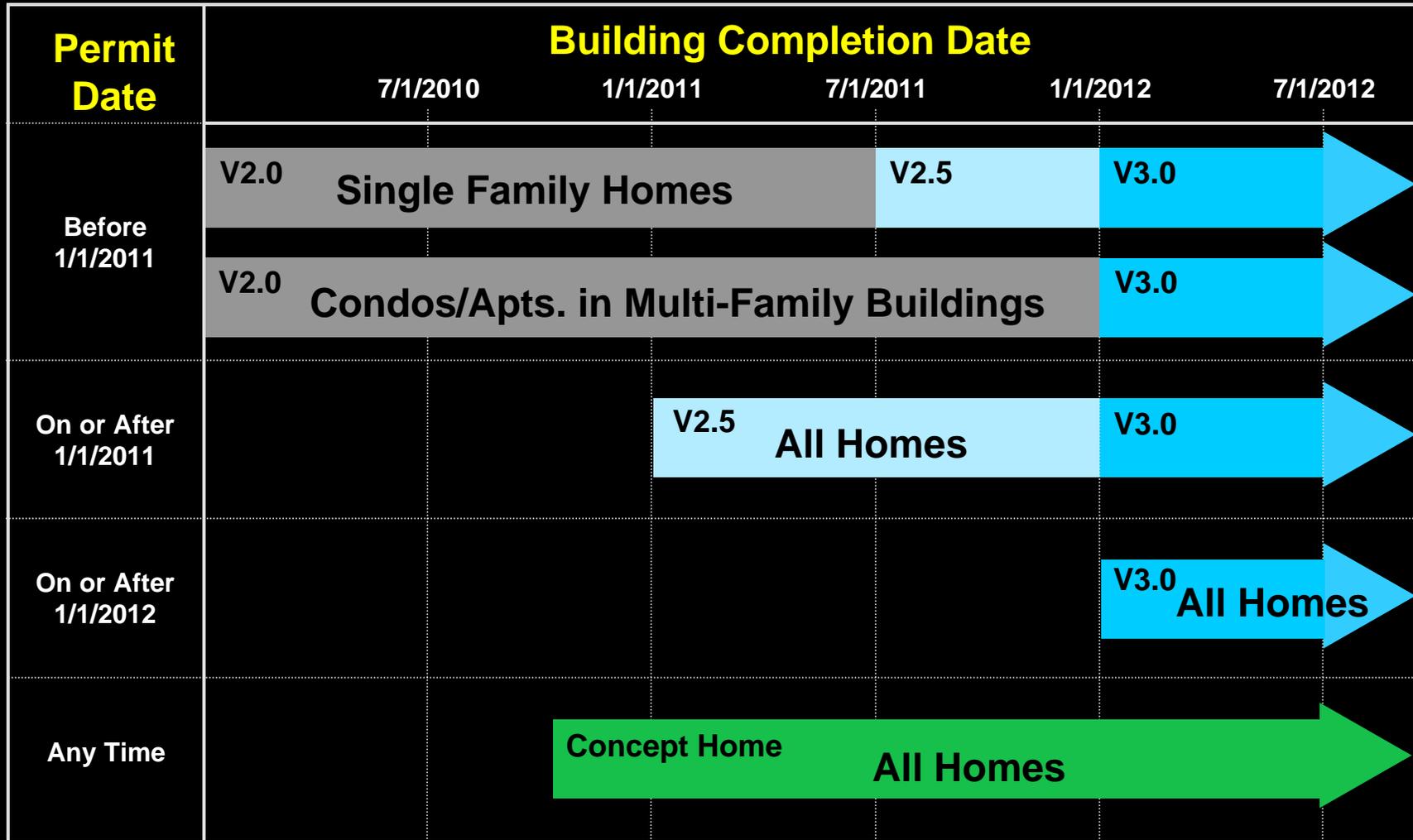
- Issue New Label
- Field Guides
- Nationwide Training
- New QA Requirements Builder and Rater
- Link with new RESNET QA Protocol
- Appraisal, Mortgage, Insurance Letter

# ENERGY STAR NEW SPEC TRANSITION



<b>Version</b>	<b>Description</b>
2.0	2006 Guidelines
2.5	Version 3 Reference Design with Air Barriers and Air Sealing Checklist Items
3.0	Version 3 Reference Design with All Checklists
4.0	ENERGY STAR Concept Home (Version 3 + EPA IAP + Adv. Techs.)

# ENERGY STAR New Homes Implementation Schedule



Version 2.0
  Version 3.0  
 Version 2.5
  Concept Home

THE BUSINESS CASE:

# RESPONDING TO NEW NORMAL



- **Attract Smaller Universe of Buyers**
- **Make Price-Based Competition Obsolete**
- **Exceed High-Performance Expectations**
- **Bring on the Infrared Cameras**

ENERGY STAR QUALIFIED HOMES METRICS:  
ENERGY STAR QUALIFIED HOMES



**Policy:**

**Carbon Reduction/Yr.**

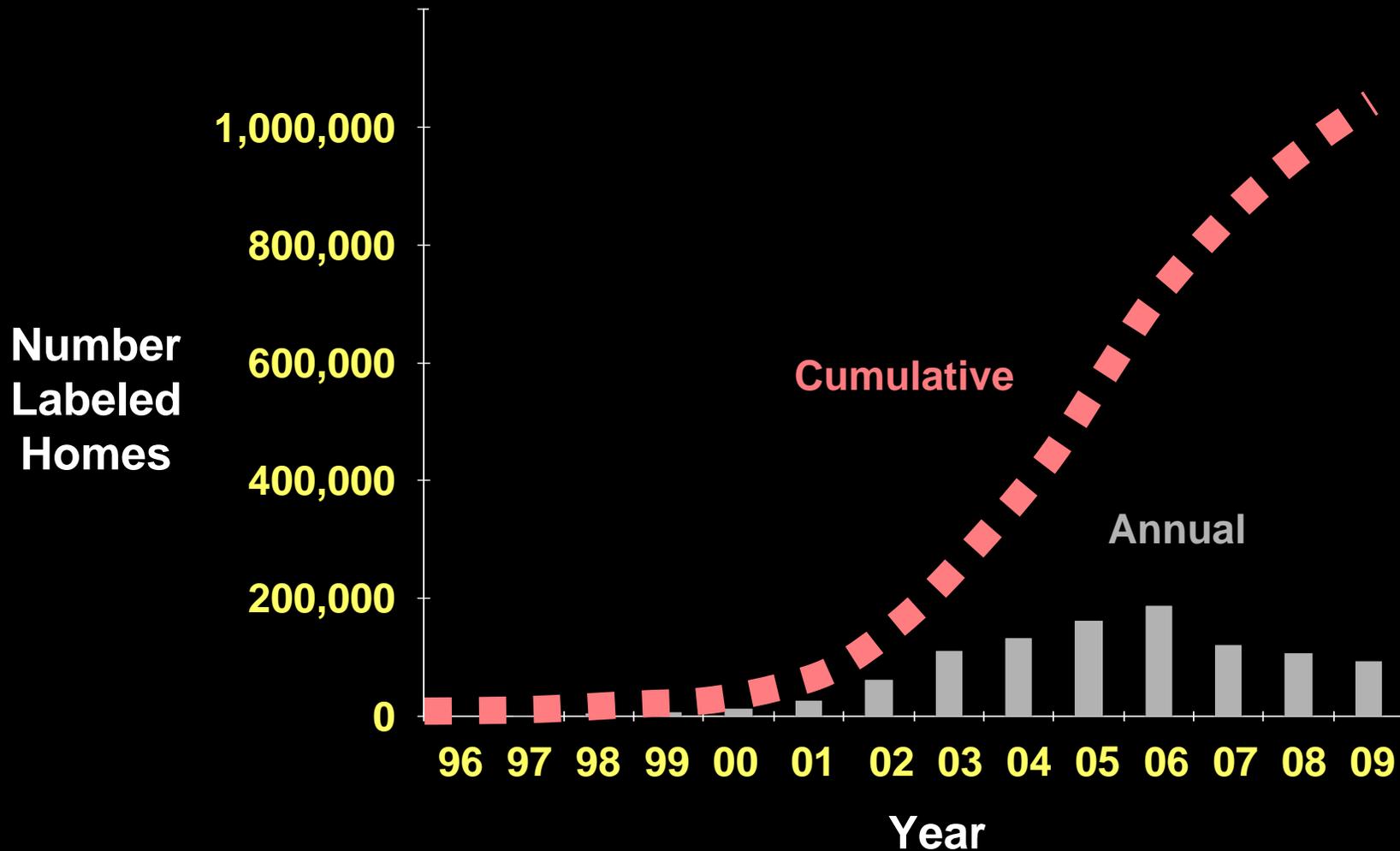
**Consumer:**

**Savings/Yr. (Energy, \$/Yr.)**

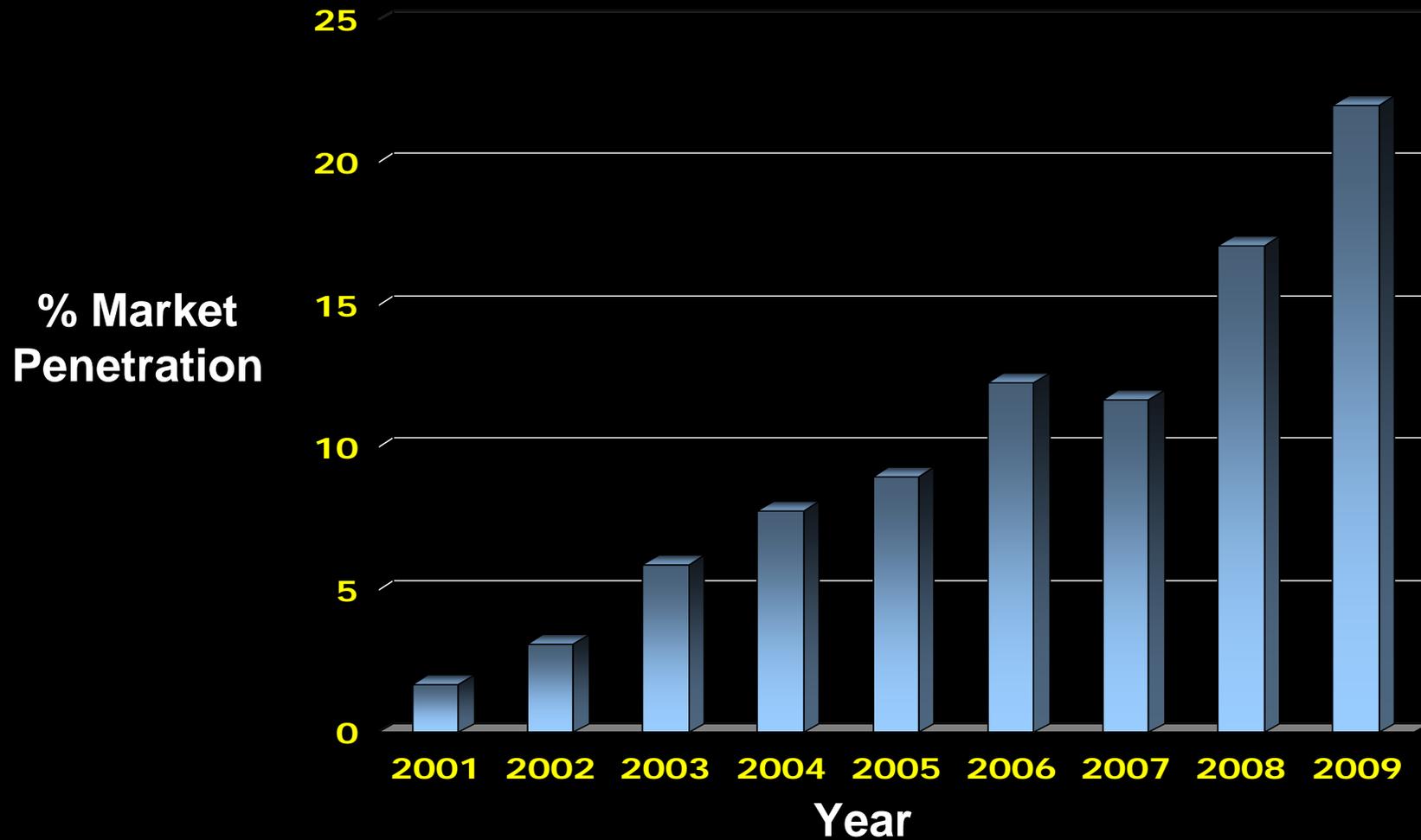
**Business:**

**Value/Builder Partner**

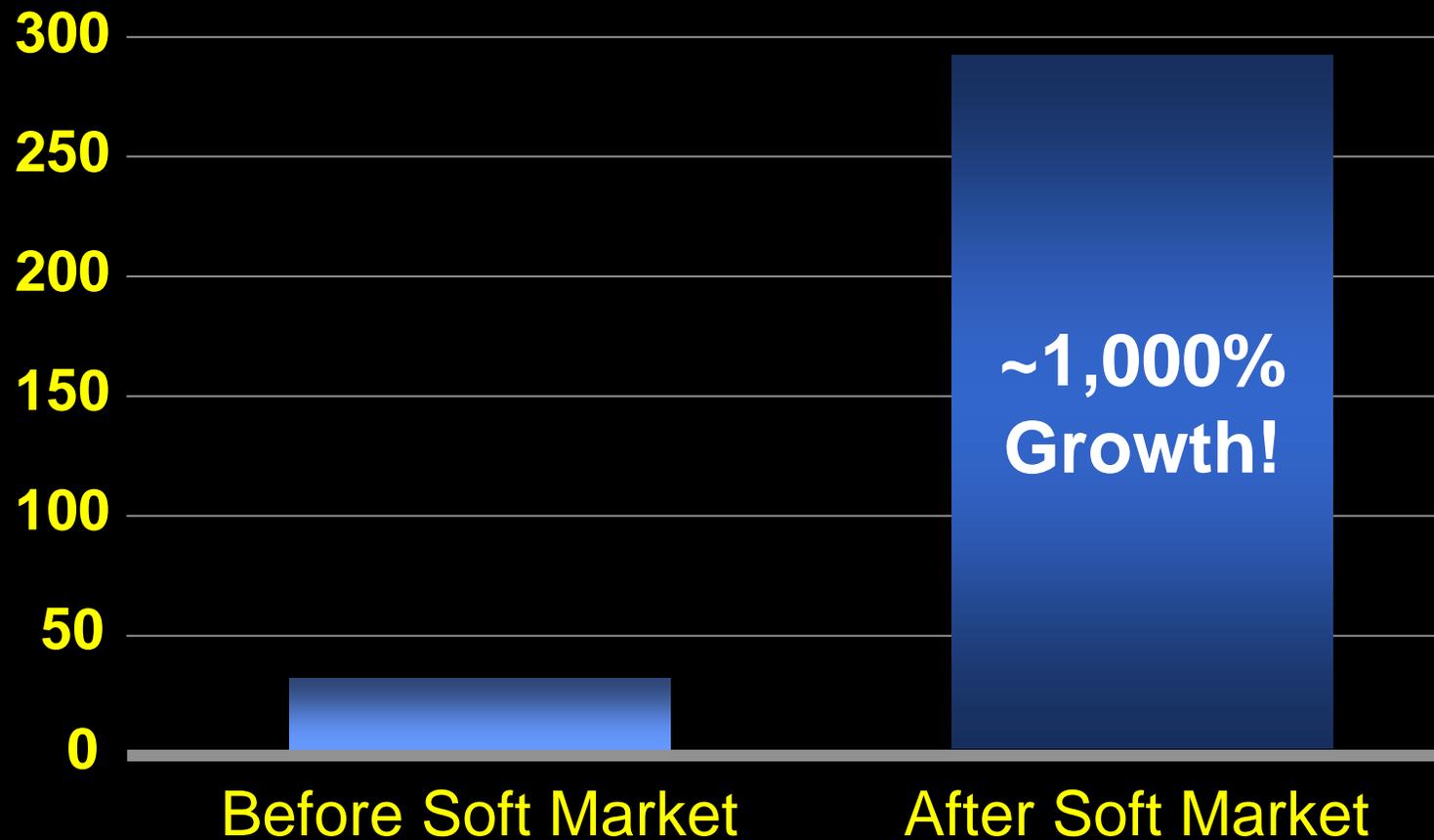
# ENERGY STAR QUALIFIED HOMES METRICS: CARBON AND SAVINGS



# ENERGY STAR QUALIFIED HOMES METRICS: CARBON AND SAVINGS



# ENERGY STAR QUALIFIED HOMES METRICS: BUILDER VALUE: PARTNERS/MONTH



ENERGY STAR QUALIFIED HOMES METRICS:  
RETURN ON TAX PAYER INVESTMENT



15-Year Investment:

**\$.025 Billion**

[total program costs]

Return:

**~\$1.5 Billion**

[consumer energy savings]

**~\$1 Billion**

[local govt. tax revenue]

**~\$1 Billion**

[non-participant savings]

**~350,000 Cars**

[GHGC emission savings]

# HOW TO GET MORE INFORMATION

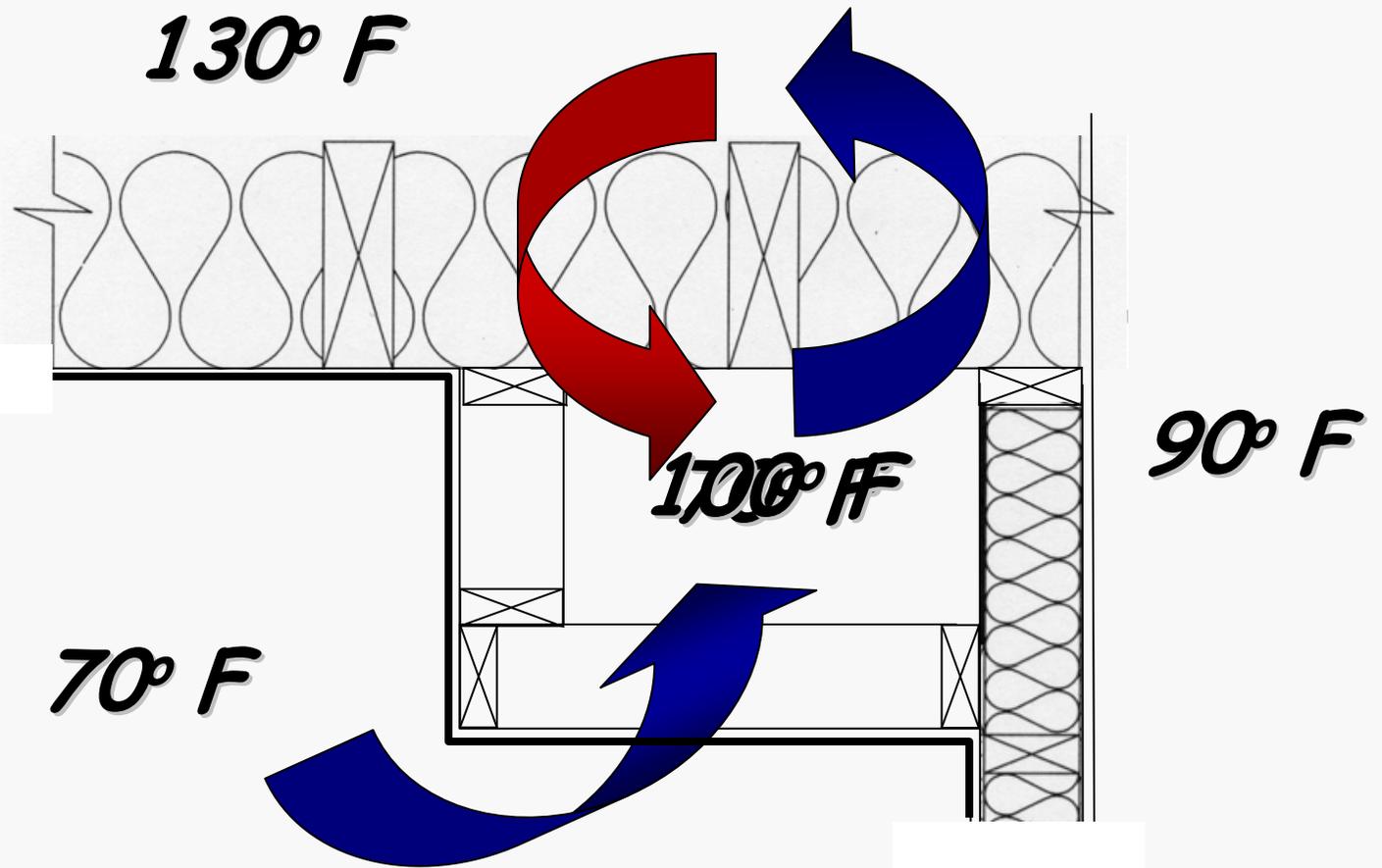


**On the Web at:**

<http://www.energystar.gov/homes>

BUILDING SCIENCE

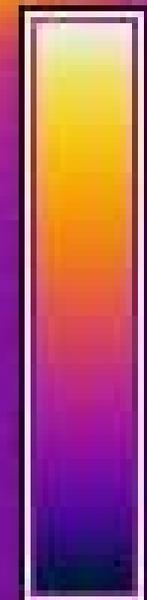
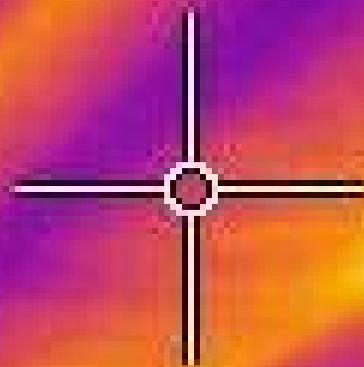
# WHY COMPLETE AIR BARRIER



 FLIR

+ 50.1 °F

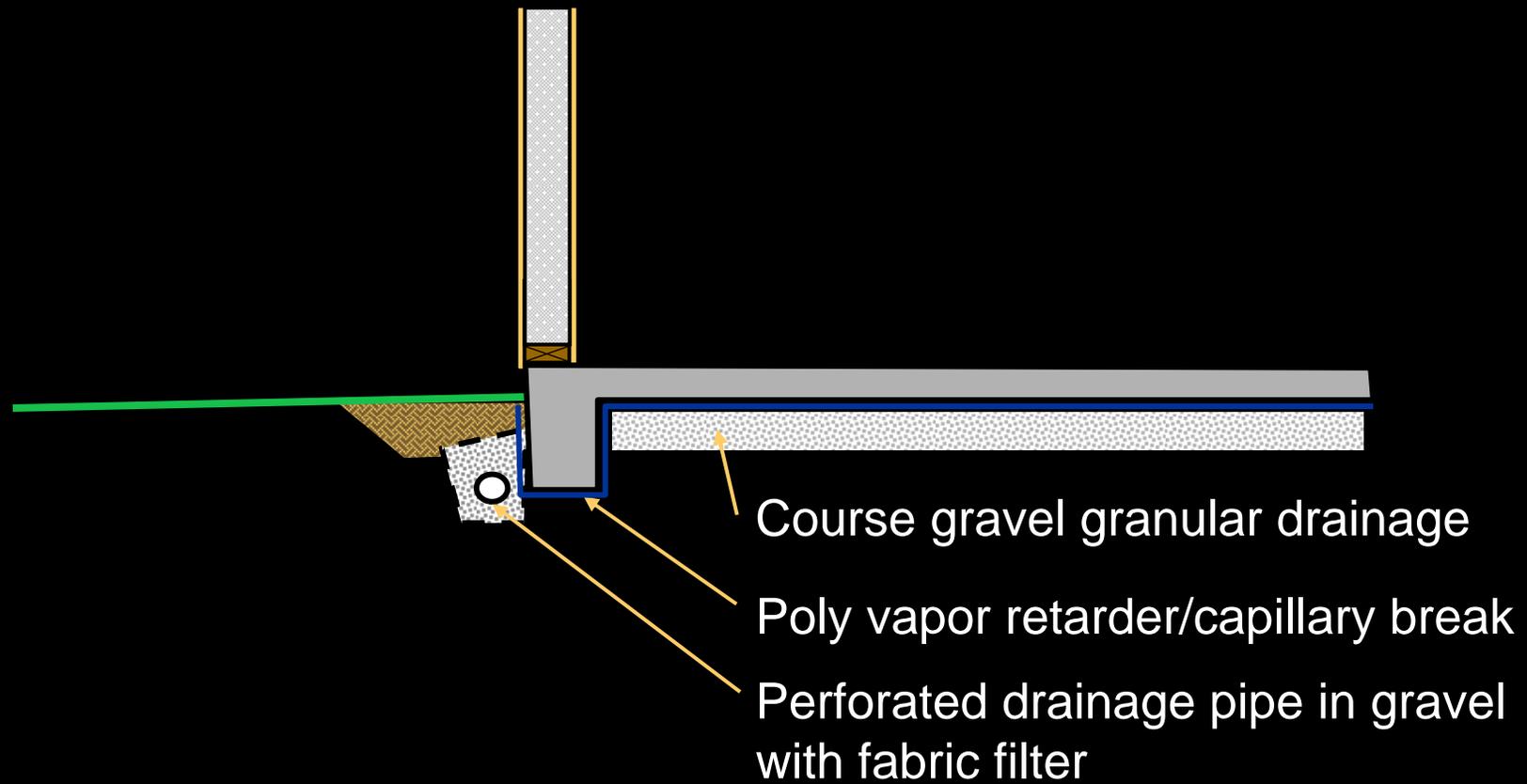
57



44

3/13/06 3:49:14 p e=0.90

# WATER MANAGED FOUNDATIONS



# REFERENCE DESIGN: CLIMATE ZONE 5 EFFICIENT HEATING/COOLING



<b>Cooling Equipment<sup>6</sup></b>	<p>Cooling equipment, where provided, meets one of the options below (check one):</p> <p><input type="checkbox"/> <math>\geq 13</math> SEER A/C    <input type="checkbox"/> Heat pump (See Heating Equipment)</p>
<b>Heating Equipment<sup>6</sup></b>	<p>Heating equipment meets one of the options below (check one):</p> <p><input type="checkbox"/> <math>\geq 90</math> AFUE gas furnace, ENERGY STAR qualified</p> <p><input type="checkbox"/> <math>\geq 85</math> AFUE oil furnace, ENERGY STAR qualified</p> <p><input type="checkbox"/> <math>\geq 85</math> AFUE boiler, ENERGY STAR qualified</p> <p><input type="checkbox"/> <math>\geq 9.25</math> HSPF / <math>14.5</math> SEER / <math>12</math> EER ENERGY STAR qualified air-source heat pump with electric backup<sup>7</sup></p> <p><input type="checkbox"/> <math>\geq 8.2</math> HSPF / <math>14.5</math> SEER / <math>12</math> EER ENERGY STAR qualified air-source heat pump with ENERGY STAR qualified dual-fuel backup</p> <p><input type="checkbox"/> Ground source heat pump, any product type, ENERGY STAR qualified<sup>8</sup></p>
<b>Thermostat &amp; Ductwork</b>	<p>Programmable thermostat installed.<sup>14</sup></p> <p>Supply ducts in unconditioned attic <math>\geq R-8</math>; All others in unconditioned space <math>\geq R-6</math></p> <p>Total duct leakage <math>\leq 6</math> CFM25 per 100 sq. ft. of CFA.<sup>15</sup></p> <p>Duct leakage to outdoors <math>\leq 4</math> CFM25 per 100 sq. ft. of CFA.<sup>16</sup></p>

# REFERENCE DESIGN: CLIMATE ZONE 5 EFFICIENT ENVELOPE



<p><b>Envelope</b></p>	<p>Infiltration rate <math>\leq 4</math> ACH50</p> <p>Insulation achieves <b>Grade I</b> installation per RESNET standards.<sup>9</sup></p> <p>Ceiling insulation <math>\geq 38</math> R-Value<sup>9</sup></p> <p>Wall insulation <math>\geq 20</math> R-Value<sup>9</sup></p> <p>Floor insulation over unconditioned space <math>\geq 30</math> R-Value<sup>9</sup></p> <p>Slab insulation <math>\geq 10</math> R-Value; Depth <math>\geq 2</math> ft<sup>9</sup></p> <p>Crawlspace wall insulation for unvented crawlspaces meets one of the options below (check one):<sup>9</sup></p> <p><input type="checkbox"/> <math>\geq 10</math> R-Value Continuous <span style="margin-left: 200px;"><input type="checkbox"/> <math>\geq 13</math> R-Value Framed Wall</span></p> <p>Basement wall insulation next to conditioned space meets one of the options below (check one):<sup>9</sup></p> <p><input type="checkbox"/> <math>\geq 10</math> R-Value Continuous <span style="margin-left: 200px;"><input type="checkbox"/> <math>\geq 13</math> R-Value Framed Wall</span></p>
<p><b>Windows &amp; Doors</b><sup>10,11,12</sup></p>	<p>Windows: <math>\leq 0.30</math> U-Value; Any SHGC</p> <p>Skylights: <math>\leq 0.55</math> U-Value; Any SHGC</p> <p>If total window-to-floor area <math>&gt;15\%</math>, then U-values or SHGCs adjusted as outlined in footnote 11.</p> <p>Door U-Value: <span style="margin-left: 50px;">Opaque: <math>\leq 0.21</math></span> <span style="margin-left: 50px;"><math>\leq \frac{1}{2}</math> lite: 0.27</span> <span style="margin-left: 50px;"><math>&gt; \frac{1}{2}</math> lite: 0.32</span></p>

# REFERENCE DESIGN: CLIMATE ZONE 5 EFFICIENT COMPONENTS



**Minimum Water Heater Efficiencies by Fuel Type and Tank Size**

Tank Size:	30 Gal	40 Gal	50 Gal	60 Gal	70 Gal	80 Gal
Gas:	0.63 EF	0.61 EF	0.59 EF	0.57 EF	0.55 EF	0.53 EF
Electric:	0.94 EF	0.93 EF	0.92 EF	0.90 EF	0.90 EF	0.89 EF
Oil:	0.55 EF	0.53 EF	0.51 EF	0.49 EF	0.47 EF	0.45 EF

<b>Water Heater</b> <sup>13</sup>	Energy Factor (EF) meets the requirements based upon fuel type and tank size. <sup>13</sup> Fuel Type: <input type="checkbox"/> Gas <input type="checkbox"/> Elec <input type="checkbox"/> Oil    Tank Size (gal.): _____    Req. EF: _____
<b>Lighting &amp; Appliances</b>	ENERGY STAR qualified refrigerators, dishwashers, ceiling fans, exhaust fans. <sup>17</sup> ENERGY STAR qualified CFLs or pin-based lighting in 80% of fixtures. <sup>18</sup>

# Albuquerque Code vs. ENERGY STAR V.3

## Areas Where Code More Stringent

- R-21 vs. R13 Wall Insulation
- Cool Roof Requirement vs. None
- R-4 Hot Water Pipe Insulation vs. None
- Low-Flow Faucets/Shower Heads vs. None

# Albuquerque Code vs. ENERGY STAR V.3

## Areas Where ENERGY STAR More Stringent

- Maximum WFA of 15%
- TEC Requirements
  - Grade 1 Insulation Installation (Only Implied in Code)
  - Thermal Bridging
  - Air Barrier Visual Inspection
  - Expanded Air Barrier Alignment
- Lower Air Infiltration (5 vs. 6 ACH50)
- High Efficiency Furnace
  - 90% AFUE vs. NAECA-minimum

# Albuquerque Code vs. ENERGY STAR V.3

## Areas Where ENERGY STAR More Stringent

- HVAC Quality Installation Requirements
  - Commissioning
  - 6 CFM/100 sf Total Duct Leakage Requirement
  - ASHRAE 62.2 Ventilation
  - Duct Installation Visual Inspection
  - Pressure Balancing
  - Filtration (MERV 6 Filter)
  - Combustion Safety (direct/power vented equipment)
- Water Management System